COESAM-PDFP-90/003

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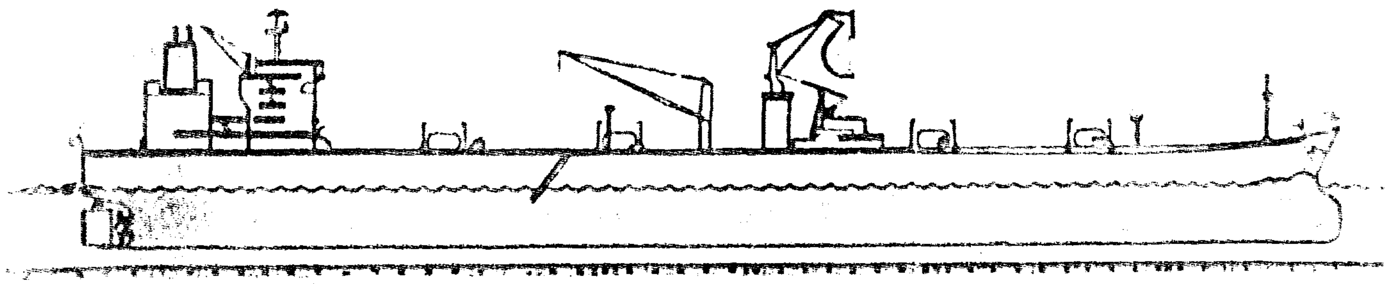
US Army Corps
of Engineers
Mobile District

GENERAL DESIGN MEMORANDUM

APPENDIX C
ECONOMIC ANALYSIS

PASCAGOULA HARBOR CHANNEL IMPROVEMENT

PASCAGOULA, MISSISSIPPI



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
Fleets of tankers and drybulk carriers carrying commodities in and out of Pascagoula Harbor were analyzed more fully load existing ships calling at this port. National benefits were derived from more efficiently using these ships.

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COESAM/PDFP-90/008

GENERAL DESIGN MEMORANDUM

PASCAGOULA HARBOR
CHANNEL IMPROVEMENT

PASCAGOULA, MISSISSIPPI

APPENDIX C
ECONOMIC ANALYSIS

Revised: February 1992

PASCAGOULA HARBOR, MISSISSIPPI
GENERAL DESIGN MEMORANDUM
APPENDIX C

TABLE OF CONTENTS

ECONOMIC BENEFITS FOR NAVIGATION

TABLE OF CONTENTS (Cont'd)

LIST OF TABLES

LIST OF TABLES (Cont'd)

LIST OF FIGURES

GENERAL DESIGN MEMORANDUM
PASCAGOULA HARBOR CHANNEL IMPROVEMENT
PASCAGOULA, MISSISSIPPI
APPENDIX C
ECONOMIC ANALYSIS
ECONOMIC BENEFITS FOR NAVIGATION

INTRODUCTION

1. This section of the report contains estimates of benefits and other supporting data pertaining to the economics of the various plans of deep draft channel improvements within the Pascagoula Harbor. The plans of improvement being considered are to increase the depth and width of the present deep draft channel leading into the Pascagoula Inner and Bayou Casotte Inner Harbors, increase the channel width through the Horn Island Pass, and provide a new turning basin in Bayou Casotte. Benefits are related to reduced transportation costs for exported grain from the Pascagoula Inner Harbor and reduced transportation costs associated with the imported crude oil and exported petroleum coke from the Bayou Casotte Inner Harbor.

PURPOSE OF STUDY

2. Based on the Pascagoula Harbor, Mississippi Feasibility Report, September, 1984, U.S. Army Corps of Engineers, Mobile District[1], channel improvements were economically, engineeringly and environmentally justified. This economic appendix shall update the needs of existing and future channel users and shall determine the National Economic Development (NED) benefits from their use of such improvements. Other pertinent economic issues shall also be addressed, such as a socio-demographic profile of the area.

SOCIO-DEMOGRAPHIC SETTING

3. One of the state's three coastal counties, Jackson, encompasses 731 square miles for an estimated 129,290 people as of 1987. Jackson County is the Pascagoula Metropolitan Statistical Area, showing a healthy increase in residents since 1950, with 31,401, to 1980 and 118,015, for a total increase of 276 percent. The growth rate from 1980 to 1987 was nearly 10 percent as compared with 5 percent for the entire state and 14.1 percent for neighboring Gulfport, Biloxi, per census data and State estimations.

4. The fluctuations in number of housing units over time are more problematic to trace. Assuming an average occupancy rate of 3.1 persons beginning with the housing and construction boom of the post-World War II years, then year-round, occupied housing numbered 10,129 in 1950. It increased to 37,589 as of 1980, a total gain of 271 percent, comparable to the increase in the

ıber of residents in the county. There are no estimates for : decade of the 1980s.

Adult residents traditionally have depended on manufacturing the major source of employment and income. Table 1 shows that : production of goods, especially durable goods, accounted for 5 percent and 41.1 percent of total employment for 1969 and '8, respectively. The projections in Table 2 indicate a :lining importance, however, as durable goods will range from 7 percent of total job holders in 1990 to 5.8 percent in the ır 2035.

Figures, historical and projected, for personal and per ›ita income echo the patterns of employment. See Tables 3 and

As recently as 1985, the quality of life in the Pascagoula :ropolitan Area is not high. In the Places Rated Almanac[2] ›lished by Rand McNally, 329 cities are ranked on the basis of .mate, housing, health, crime, transportation, education, the :s, recreation and economic forecasts. Overall, Pascagoula ıced 271st, behind Mobile, Alabama, at 223rd and far in back of ' Orleans, Louisiana, at 53rd. Indeed, of the nine factors ;ted above, it scored well only on the availability and costs housing (35th) and on a comparatively low crime rate (52nd). the category of economic forecasts, it placed 277th due to .atively low income levels, disproportionately high state :ome and sales taxes and a projected contraction of jobs by 10 ·cent over a 5-year period.

Tributary Area. The geographical area served by the Port of ;cagoula is broad in both a domestic and foreign scope. The ıestic area where the port has a truck rate advantage over ıer Gulf Coast ports encompasses a small area of southern ;sissippi. The domestic area served via barges by the Port of ;cagoula is considerably smaller in size than the area served the Port of New Orleans but is comparable to the area served the Port of Mobile. On a world-wide basis, however, the Port Pascagoula can transport commodities to foreign destinations .t as efficiently as any other Gulf Coast port. A delineation the boundaries of the tributary area is shown in Figure 1.

TABLE 1
JACKSON COUNTY, MS.

HISTORICAL EMPLOYMENT BY INDUSTRY (TOTAL NUMBER OF JOBS)[3]

INDUSTRY	1969	1978
Total Employment	33,439	55,128
Farm	366	296
Ag. Serv., For., Fish.	481	254
Mining	54	59
Construction	2,626	3,862
Total Manufacturing	15,560	27,339
Non-Durable Goods	4,040	4,692
Food & Kindred	DN	DN
Textiles	DN	DN
Paper & Allied	DN	DN
Chemicals & Allied	DN	DN
Petroleum Refining	DN	DN
Durable Goods	11,520	22,647
Primary Metals	DN	DN
Stone, Clay & Glass	DN	DN
Transp. & Public Util.	820	1,161
Wholesale Trade	493	1,027
Retail Trade	3,239	5,875
Finance, Ins. & R.E.	669	1,443
Services	3,862	5,405
Total Government	5,269	8,407
Federal, Civilian	358	653
Federal, Military	1,133	1,753
State & Local	3,778	6,001

D Not shown to avoid disclosure of confidential information, data are included in higher level totals.

N Not reported.

Note: Projected two-digit employment data in Manufacturing are shown only for selected industries, therefore they will not add to Total Durable Employment and Total Non-Durable Employment.

Source: 1985 OBERS BEA Regional Projections, Vol. 2, USDC, Bureau of Economic Analysis

TABLE 2
JACKSON COUNTY, MS.

PROJECTED EMPLOYMENT BY INDUSTRY (TOTAL NUMBER OF JOBS)[4]

TRY	1990	2000	2035
Employment	56,879	63,635	69,505
	265	256	218
erv., For., Fish.	504	599	628
g	14	14	15
ruction	4,600	5,324	5,991
Manufacturing	23,156	23,731	22,166
-Durable Goods	4,534	4,613	4,262
ood & Kindred	921	991	868
extiles	41	41	37
aper & Allied	1,058	1,010	915
hemicals & Allied	639	642	575
etroleum Refining	1,289	1,480	1,767
able Goods	18,622	19,118	17,904
rimary Metals	31	37	41
tone, Clay & Glass	277	278	271
p. & Public Util.	1,637	1,974	2,362
sale Trade	1,421	1,752	2,328
l Trade	7,768	9,624	12,179
ce, Ins. & R.E.	1,828	2,275	2,710
ces	6,942	8,780	11,349
Government	8,749	9,288	9,559
eral, Civilian	676	719	773
eral, Military	1,279	1,279	1,279
te & Local	6,794	7,290	7,507

Projected two-digit employment data in Manufacturing are only for selected industries, therefore they will not add tal Durable Employment and Total Non-Durable Employment.

e: <u>1985 OBERS BEA Regional Projections, Vol. 2</u>, USDC, u of Economic Analysis

TABLE 3
JACKSON COUNTY, MS.

HISTORICAL TOTAL PERSONAL INCOME, PER CAPITA INCOME, AND EARNINGS BY INDUSTRY[5]

INDUSTRY	1969	1978
Total Personal Income	274,163	494,474
Population (number)	85,000	118,400
Per Capita Income	3,225	4,176
Per Capita Relative	77	80
Total Earnings	262,471	499,397
Farm	690	793
Ag. Serv., For., Fish.	2,374	732
Mining	468	467
Construction	23,955	34,665
Total Manufacturing	156,447	317,786
Non-Durable Goods	38,690	59,137
Durable Goods	117,757	258,649
Transp. & Public Util.	5,985	11,206
Wholesale Trade	4,209	9,301
Retail Trade	18,524	31.235
Finance, Ins. & R.E.	5,378	11,201
Services	18,877	36,518
Total Government	25,564	45,493
Federal, Civilian	3,899	8,577
Federal, Military	3,106	3,565
State & Local	18,559	33,351

Notes: Earnings and Total Personal Income are in thousands of 1972 dollars.
Per Capita Personal Income is in 1972 dollars.
Per Capita Relative: US = 100.

Source: 1985 OBERS BEA Regional Projections, Vol. 2, USDC, Bureau of Economic Analysis

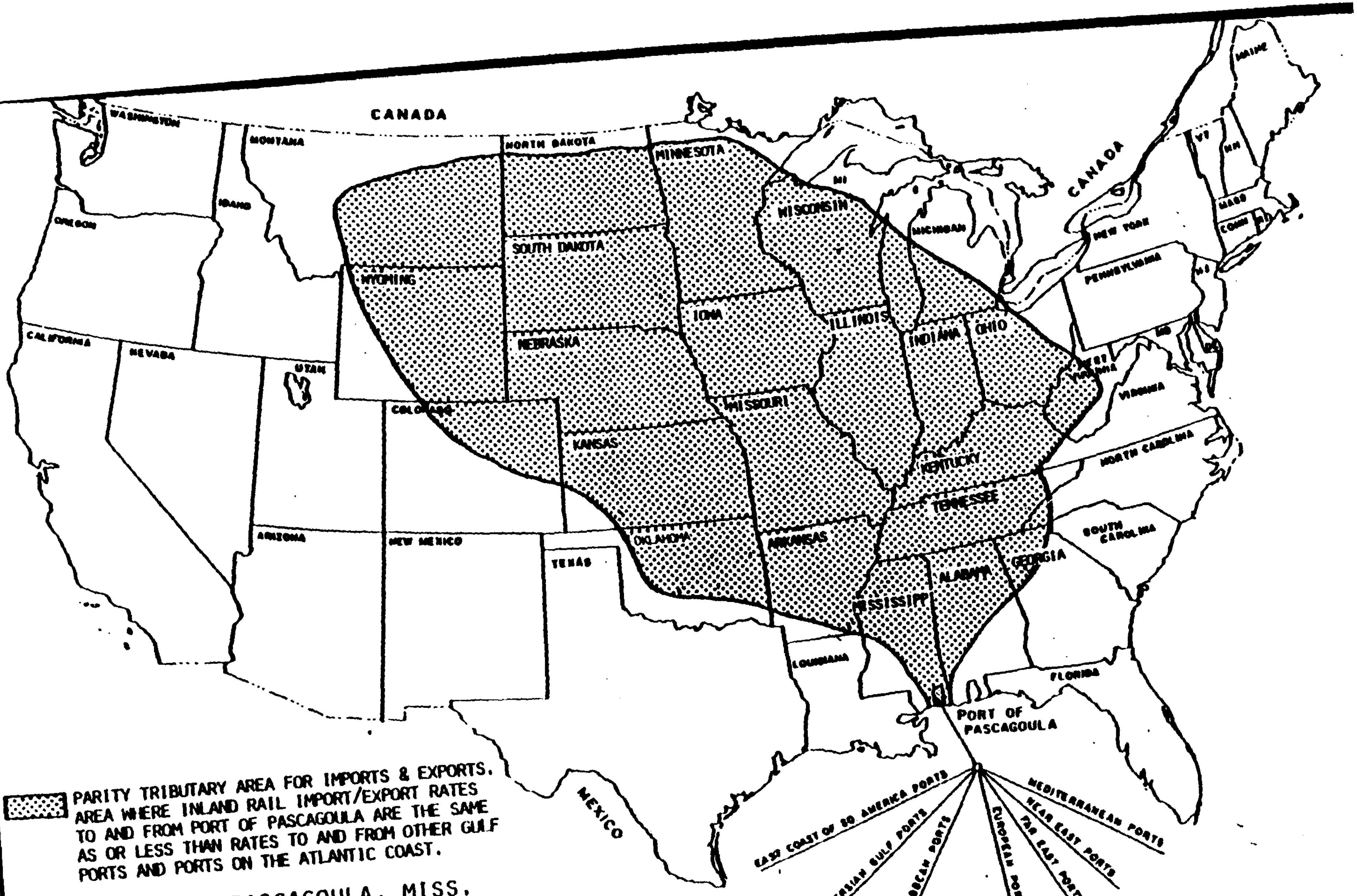
TABLE 4
JACKSON COUNTY, MS.

PROJECTED TOTAL PERSONAL INCOME, PER CAPITA INCOME, AND EARNINGS BY INDUSTRY[6]

INDUSTRY	1990	2000	2035
Total Personal Income	752,563	951,163	1,580,076
Population (number)	144,578	158,619	188,288
Per Capita Income	5,205	5,997	8,392
Per Capita Relative	81	81	83
Total Earnings	643,782	799,972	1,234,128
Farm	533	624	807
Ag. Serv., For., Fish.	1,290	1,684	2,547
Mining	352	426	644
Construction	47,817	60,044	94,742
Total Manufacturing	383,964	457,629	654,628
Non-Durable Goods	83,750	99,691	143,810
Durable Goods	300,214	357,938	510,813
Transp. & Public Util.	21,684	30,281	53,738
Wholesale Trade	11,717	15,602	27,733
Retail Trade	37,800	49,645	83,904
Finance, Ins. & R.E.	16,401	22,213	35,649
Services	58,962	85,681	163,205
Total Government	63,262	76,143	116,536
Federal, Civilian	9,269	11,119	17,632
Federal, Military	5,628	6,220	8,831
State & Local	48,365	58,804	90,073

Notes: Earnings and Total Personal Income are in thousands of 1972 dollars.
Per Capita Personal Income is in 1972 dollars.
Per Capita Relatives: US = 100.

Source: 1985 OBERS BEA Regional Projections, Vol. 2, USDC, Bureau of Economic Analysis



PORT OF PASCAGOULA, MISS.

TRIBUTARY AREA

9. Study Methodology. A traffic survey was conducted which identified the present and future users. These existing and potential future channel users were interviewed to determine the types and volumes of commerce and their origins and destinations. Other pertinent data developed regarding the commerce included identification of transportation modes, exact transportation charges for each mode, singular or multiple, to or from the hinterland of the United States. All these data were used to establish commerce patterns, tonnages and unit costs for the three conditions which must be analyzed for each commodity. These three conditions are existing condition, without-project condition and with-project condition(s). The "base" year is the first year of the without-project period.

10. Traffic Survey. Twenty firms were interviewed for the above mentioned data. These firms are listed below:

a. Jackson County Port Authority
b. Chevron, U.S.A.*
c. Chevron Shipping, Inc.*
d. Havea Transport, Inc.
e. Bulk Shipping, Inc.*
f. Johnson Maritime Services Gulf, Inc.*
g. NuSouth, Inc.*
h. First Chemical Corporation
i. Ingalls Shipbuilding Corporation
j. Louis Dreyfus Corporation*
k. M&M, Division of HAM Industries, Inc.*
l. Pascagoula Bar Pilots Association*
m. Waterman Steamship Lines*
n. McMillan-Blodel
o. Mississippi Power Company
p. Colle Towing Co., Inc.*
q. Southern Steamship Agency, Inc.*
r. U.S. Customs, Pascagoula
s. Journal of Commerce, Mobile
t. SSM Carbon, Inc.*

*This firm or facility would benefit from an improved channel.

11. Planned Port Facilities. New companies and expansions of the existing companies were also identified.

a. Pascagoula Inner Harbor Channel. A Navy homeport will be completed in 1990 on Singing River Island, which is located almost adjacent to, but south of the Litton Industries facilities on the west bank. These vessels can be accommodated with the existing 38-foot channel.

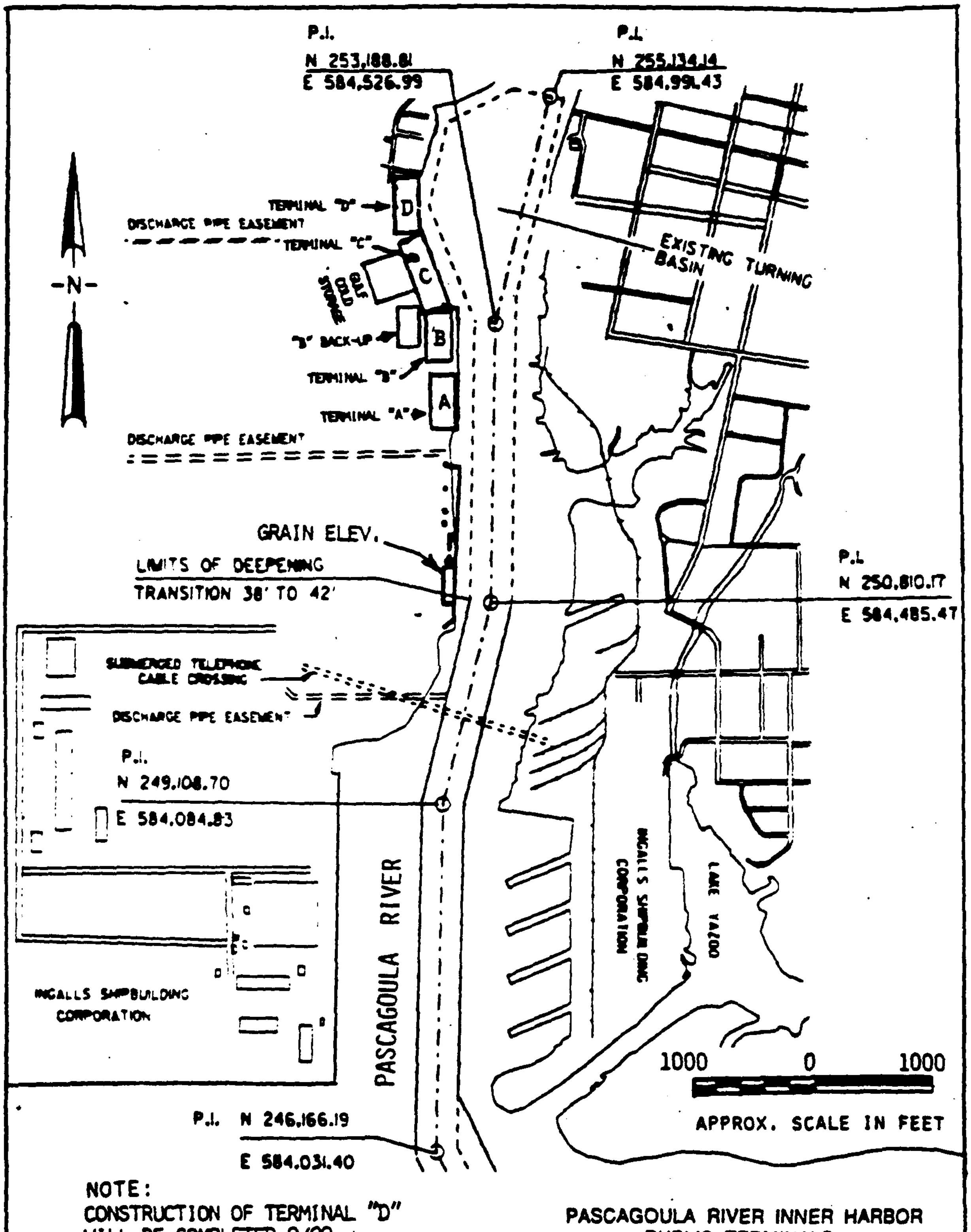
b. Bayou Casotte Inner Harbor Channel. Numerous manufacturing companies (titanium dioxide and other chemicals) are being actively pursued by the Jackson County Port Development Group to be located at a 450-acre airport site. The site has access to the port facilities at Terminals "G" and "H" by loading and discharging pipes for deep-draft and shallow-draft vessel usage A portion of "Greenwood Island", located on the west side of the channel at its mouth, is also being used by the Port's development group for enticing new industries.

12. Benefit Methodology. Transportation benefits that would accrue to a deeper channel at Pascagoula Harbor were generated by more efficient utilization (more fully loading) of present and future vessels calling at the port, reduced vessel transit and turning times, times spent in port, reductions in vessel time waiting outside the bar, reductions of number of vessel shifts and tugs, and other benefit categories. Benefits were computed as the difference in transportation costs for the without-project condition and the with-project condition(s). All future benefits are discounted to their present value and then amortized over the project life (1996-2046) at the FY 1991 interest rate (8 3/4 percent).

EXISTING PORT FACILITIES

13. General. The Pascagoula Harbor Complex consists of two port areas. One is located at the mouth of the Pascagoula River and designated hereafter as the "Pascagoula Inner Harbor Channel." The other area is the industrial complex located to the east of Pascagoula at Bayou Casotte designated hereafter as the "Bayou Casotte Inner Harbor Channel." Figures 2 and 3, respectively, show the location of each of the following mentioned docks/terminals along these two channels.

14. Pascagoula Inner Harbor Channel: Port and dock facilities located on the Pascagoula Inner Harbor channel consist of four public terminals and warehouses designated as terminals "A", "B", "C" and "D" owned and operated by Jackson County Port Authority. Litton Industries operates a large ship construction facility on the west bank of the Pascagoula Inner Harbor Channel and a large ship and submarine repair yard on the east bank of the Pascagoula Inner Harbor channel. The Jackson County Grain Terminal is leased and operated by Louis Dreyfus Corporation. Under the terms of the lease, this facility is operated as a public grain terminal available to all grain shippers on equal terms. The Jackson County Port Authority is authorized and empowered to establish rates and charges for all services at the terminal pursuant to Chapter 99, Laws of Mississippi of 1956, as amended. Shippers other than Dreyfus utilize the grain terminal for exporting grain. The terminal presently has a throughput capacity of 6 million tons per year and additional capacity can readily be added when demand justifies it. M&M Pipe operates an



PASCAGOULA RIVER INNER HARBOR
PUBLIC TERMINALS

FIGURE C-2

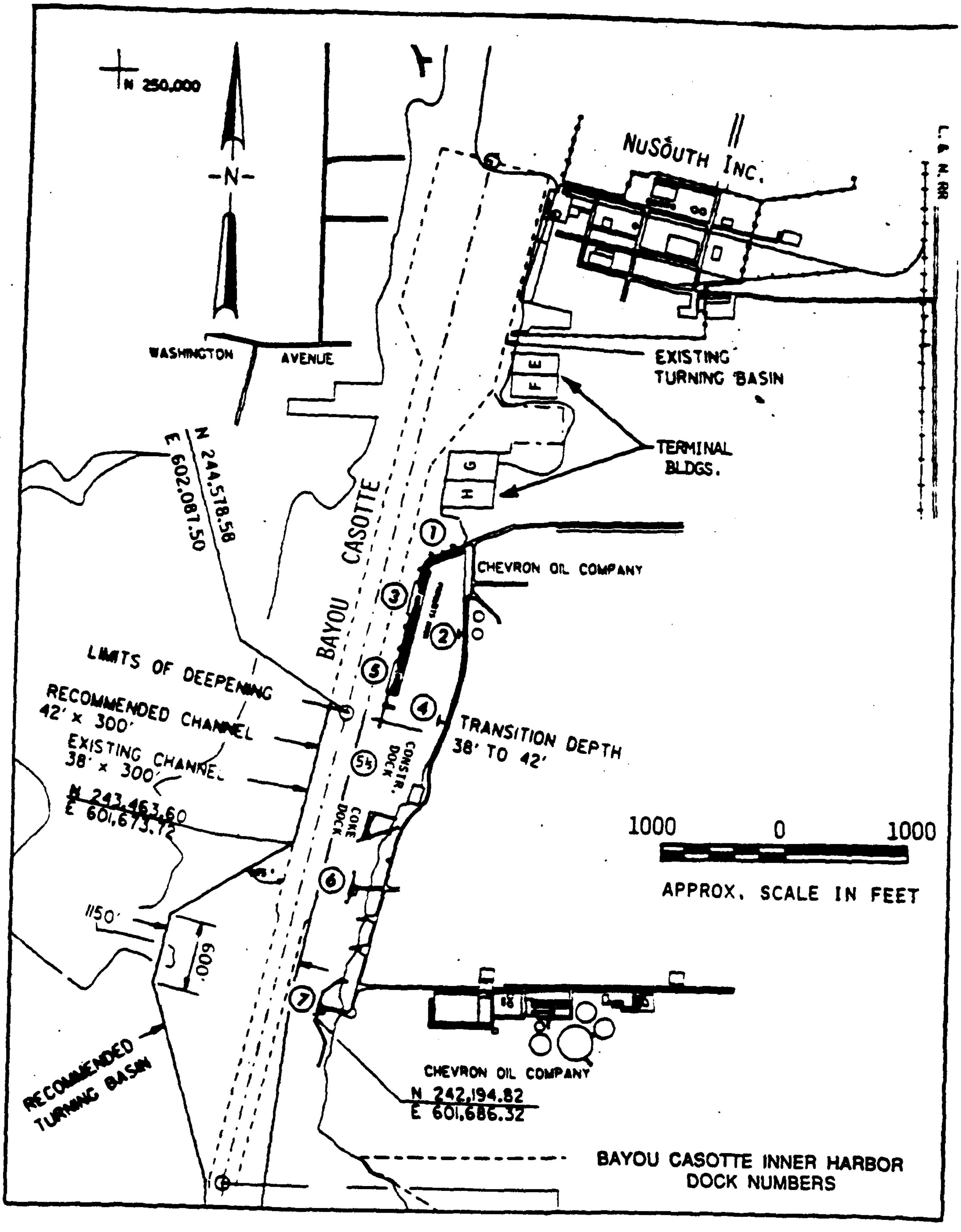

N 250,000
-N-
NUSOUTH INC.
L & N RR
WASHINGTON
AVENUE
EXISTING
TURNING BASIN
TERMINAL
BLDGS.
F
E
G
H
N 244,578.58
E 602,087.50
BAYOU CASOTTE
CHEVRON OIL COMPANY
LIMITS OF DEEPENING
RECOMMENDED CHANNEL
42' x 300'
EXISTING CHANNEL
38' x 300'
TRANSITION DEPTH
38' TO 42'
CONSTR. DOCK
COKE DOCK
N 243,463.60
E 601,673.72
1000
0
1000
APPROX. SCALE IN FEET
1150'
600'
RECOMMENDED
TURNING BASIN
CHEVRON OIL COMPANY
N 242,194.82
E 601,686.32
BAYOU CASOTTE INNER HARBOR
DOCK NUMBERS

FIGURE C-3

oil drilling rig repair facility north of terminal "D" on the turning basin on the west side of the Pascagoula Inner Harbor channel. Other private docks, terminals, repair yards, and fish houses are owned or operated by Heinz and Finicky Pet Foods, Walker Shipyard, Champion Industrial Fabrication, Gulf City Fisheries, Halter Marine, Zapata Haynie and Standard Fish Meal Companies, International Paper Company, Colle Towing Company, Havea Transport, Inc., and numerous other fishing and small boat repair facilities.

15. These Jackson County Port Authority terminals are used for importing and exporting mostly break-bulk cargo. Louis Dreyfus docks are used for loading bulk and bagged grain onto ocean going vessels for export, and unloading grain barges that originate in the Midwest. Litton Industries facilities are used for constructing and repairing vessels and launching new ships or drydocked vessels under repair. M&M Pipe facilities are used for repairing small and large oil or natural gas drilling rigs. Havea Transport facilities on the east side of the channel are used for importing liquid latex rubber.

16. <u>Bayou Casotte Inner Harbor Channel</u>: On the Bayou Casotte channel, the Jackson County Port Authority owns and operates terminals "E", "F", "G", and "H." Chevron, U.S.A. operates a large petroleum and chemical refinery and ship/barge docking facilities. First Chemical Corporation and NuSouth, Inc., are chemical companies, which have plants and/or dock facilities on the Bayou Casotte Inner Harbor Channel. First Chemical Corporation has a plant adjacent to the turning basin, but uses Jackson County Port Authority terminal "F" for docking, loading and unloading vessels. NuSouth, Inc., a chemical fertilizer manufacturer, operates loading and discharge facilities on the northeastern side of the turning basin.

17. Chevron, U.S.A., Inc. docks are used for importing crude oil and shipping petroleum and chemical products out by tankers and barges. Chevron has constructed new facilities at Bayou Casotte for receiving and processing 17.2 million tons of foreign crude per year. The crude oil arrives at a position 25 miles offshore in Very Large Crude Carriers (VLCCs) and Ultra Large Crude Carriers (ULCCs) and is lightered to the refinery docks in smaller tankers. Outbound petroleum products are carried in dry bulk carriers (petroleum coke) and tankers, ocean-going and inland barges. Approximately 12 tankers per year (35,000 dwt class) export Chevron's finished products to foreign ports. Starting in early 1991, these vessels will deliver approximately 400,000 short tons to foreign destinations and could have drafts greater than 36 feet. These 12 vessels have been excluded from the deepening alternatives since trends of destinations had not been established with less than one year of data, but were included in the bar widening and new turning basin alternatives.

18. NuSouth, Inc. uses their docks for bringing in phosphate rock from Tampa, Florida in ocean-going barges and dry bulk carriers and shipping out ammonia by tankers. Other dock facilities at the two ports are used for loading or unloading lash and RoRo vessels and other small, shallow draft vessels.

EXISTING PORT COMMERCE

19. Pascagoula Inner Harbor Channel. Waterborne commerce for the Port of Pascagoula reached 27.8 million short tons of commerce for 1987 and 29.1 million tons for 1988 based on waterborne commerce data and port records. Latest published waterborne commerce[7] data for the port is 1987 (Table 5). Over 93 percent of the tonnage in Table 5 is Bayou Casotte tonnage. Accordingly, the tonnage moving over the Pascagoula Inner Harbor channel amounted to 1,817,344 tons. See Table 6 for a historical perspective of waterborne commerce for both channels.

20. Principal products on the Pascagoula Inner Harbor channel in 1988 were grain, rubber, lumber, and wood chips and pulpwood, and other break-bulk commodities.

21. Bayou Casotte Inner Harbor Channel. Based on Table 7, waterborne commerce for Bayou Casotte in 1987 was 26,007,471 short tons. Table 8 shows that commerce for this channel has fluctuated from 17.5 to 28.3 million tons in 1982 and 1988 respectively. Principal products are imported crude oil and exported petroleum coke. Numerous outbound petroleum products are transported coastwise within the U.S. ports; however, few of these shipments are in deep-draft tankers with greater than a 36-foot draft. Internal shipments in Table 7 are barge movements of these petroleum products.

22. Summary. The major waterborne commodities handled at Pascagoula, including both channels during CY 1987 by deep-draft vessels were: grain, crude petroleum, fertilizer and fertilizer material, petroleum products, chemicals, and general break-bulk cargo. A break-down of this commerce is shown in Table 9.

TABLE 5
1987 WATERBORNE COMMERCE, PASCAGOULA INNER HARBOR AND BAYOU CASOTTE INNER CHANNELS

FREIGHT TRAFFIC, 1987

(SHORT TONS)

COMMODITY	TOTAL	FOREIGN IMPORTS	FOREIGN EXPORTS	DOMESTIC COASTWISE RECEIPTS	DOMESTIC COASTWISE SHIPMENTS	DOMESTIC INTERNAL RECEIPTS	DOMESTIC INTERNAL SHIPMENTS	LOCAL
TOTAL	27,826,815	14,466,236	3,083,333	59,712	5,130,666	1,018,675	6,115,570	21,6[illegible]
0101 COTTON, RAW	20	-	20	-	-	-	-	-
0103 CORN	657,712	-	635,389	-	-	20,923	1,400	-
0105 RICE	1,732	-	1,732	-	-	-	-	-
0106 SORGHUM GRAINS	197,039	-	162,570	-	-	1,653	32,816	-
0107 WHEAT	201,185	-	113,472	-	-	79,773	7,940	-
0111 SOYBEANS	317,680	-	265,742	-	-	47,221	4,717	-
0119 OILSEEDS, NEC	447	-	447	-	-	-	-	-
0120 FIELD CROPS, NEC	21	21	-	-	-	-	-	-
0161 FRESH AND FROZEN VEGETABLES	209	-	209	-	-	-	-	-
0841 CRUDE RUBBER AND ALLIED GUMS	69,153	69,153	-	-	-	-	-	-
0911 FRESH FISH, EXCEPT SHELLFISH	11,450	-	965	-	-	10,485	-	-
0912 SHELLFISH, EXCEPT PREPARED	321	-	-	-	-	321	-	-
0931 MARINE SHELLS, UNMANUFACTURED	20,500	-	-	-	-	20,500	-	-
1091 NONFERROUS ORES, CONCENT, NEC	3,046	-	-	-	-	-	3,046	-
1311 CRUDE PETROLEUM	14,271,671	14,271,671	-	-	-	-	-	-
1411 LIMESTONE	16,980	-	-	-	-	16,980	-	-
1442 SAND, GRAVEL, CRUSHED ROCK	30,186	24	-	-	-	30,162	-	-
1451 CLAY	636	-	636	-	-	-	-	-
1471 PHOSPHATE ROCK	42,035	-	5,527	36,508	-	-	-	-
1493 SULPHUR, LIQUID	266,456	-	-	-	194,836	8,910	62,710	-
1496 GYPSUM, CRUDE AND PLASTERS	32,143	-	-	-	-	-	32,143	-
2011 MEAT, FRESH, CHILLED, FROZEN	26,523	-	26,523	-	-	-	-	-
2012 MEAT AND PRODUCTS, NEC	20	20	-	-	-	-	-	-
2015 ANIMAL BY-PRODUCTS, NEC	20	20	-	-	-	-	-	-
2021 DAIRY PRODUCTS, NEC	1,297	-	1,297	-	-	-	-	-
2022 DRIED MILK AND CREAM	3,574	-	3,574	-	-	-	-	-
2041 WHEAT FLOUR AND SEMOLINA	5,675	-	5,675	-	-	-	-	-
2042 ANIMAL FEEDS	707	-	-	-	-	707	-	-
2049 GRAIN MILL PRODUCTS, NEC	4,519	-	1,877	-	-	1,450	1,192	-
2062 MOLASSES	1,346	-	-	-	-	-	1,346	-
2091 VEGETABLE OILS, MARG, SHORT	2,153	-	974	-	-	1,179	-	-
2095 ICE	2,241	-	-	-	-	-	2,241	-
2099 MISCELLANEOUS FOOD PRODUCTS	8,261	165	6,646	-	-	1,450	-	-
2211 BASIC TEXTILE PRODUCTS	101	98	3	-	-	-	-	-
2212 TEXTILE FIBERS, NEC	13	-	13	-	-	-	-	-
2311 APPAREL	712	262	450	-	-	-	-	-
2416 WOOD CHIPS, STAVES, MOLDINGS	29,458	-	-	-	-	29,458	-	-
2421 LUMBER	39,269	39,269	-	-	-	-	-	-
2431 VENEER, PLYWOOD, WORKED WOOD	12	12	-	-	-	-	-	-
2491 WOOD MANUFACTURES, NEC	22	22	-	-	-	-	-	-
2611 PULP	155,963	813	48,532	-	-	-	106,618	-
2621 STANDARD NEWSPRINT PAPER	26,483	26,483	-	-	-	-	-	-
2631 PAPER AND PAPERBOARD	5,337	5,331	6	-	-	-	-	-
2816 SODIUM HYDROXIDE	48,618	-	-	-	-	48,618	-	-
2811 CRUDE TAR, OIL, GAS PRODUCTS	3,046	-	-	-	-	3,046	-	-
2812 DYES, PIGMENT, TANNING MATS	2	-	2	-	-	-	-	-
2817 BENZENE AND TOLUENE	131,485	-	-	-	-	116,474	15,011	-
2818 SULPHURIC ACID	239,008	-	-	-	-	124,773	114,235	-
2819 BASIC CHEMICALS AND PROD, NEC	275,031	13,200	105,877	-	4,561	42,361	109,032	-
2821 PLASTIC MATERIALS	101	-	101	-	-	-	-	-
2822 SYNTHETIC RUBBER	48,232	-	27	-	-	36,475	11,730	-
2831 DRUGS	9	-	9	-	-	-	-	-
2841 SOAP	38	-	38	-	-	-	-	-
2851 PAINTS	659	659	-	-	-	-	-	-
2861 GUM AND WOOD CHEMICALS	60,563	-	-	-	-	31,454	29,109	-
2871 NITROGENOUS CHEM FERTILIZERS	24,587	-	-	-	-	5,000	19,587	-
2872 POTASSIC CHEM FERTILIZERS	58,706	-	-	-	-	51,600	7,106	-
2873 PHOSPHATIC CHEM FERTILIZERS	1,364	-	-	-	-	1,364	-	-
2876 INSECTICIDES, DISINFECTANTS	101	97	4	-	-	-	-	-
2879 FERTILIZER AND MATERIALS, NEC	107,120	-	189	-	-	8,782	91,059	7,090
2891 MISCELLANEOUS CHEMICAL PROD	169	-	169	-	-	-	-	-
2911 GASOLINE	3,820,883	-	85,822	1,602	2,511,097	68,019	1,152,863	-
2912 JET FUEL	1,126,419	-	46,306	-	843,359	-	236,754	-
2914 DISTILLATE FUEL OIL	[illegible]	-	759,553	-	1,245,260	45,349	536,292	10,92[illegible]
2915 RESIDUAL FUEL OIL	569,163	27,900	-	20,420	227,262	62,030	231,551	-
2916 LUBRICATING OILS AND GREASES	25,605	-	9,001	-	-	-	16,604	-
2917 NAPHTHA, PETROLEUM SOLVENTS	74,610	-	-	-	-	15,528	59,082	-
2918 ASPHALT, TAR, AND PITCHES	717,103	-	-	-	6,796	-	710,307	-
2920 COKE, PETROLEUM COKE	1,315,894	-	1,282,438	-	-	-	33,456	-
2921 LIQUEFIED GASES	300,986	-	-	1,020	145,612	53,994	100,360	-
2991 PETROLEUM AND COAL PROD, NEC	293,436	-	3,266	-	-	21,755	268,415	-
3011 RUBBER AND MISC PLASTIC PROD	415	326	89	-	-	-	-	-
3251 STRUCTURAL CLAY PRODUCTS	9,658	-	-	-	-	-	9,658	-
3291 MISC NONMETALLIC MINERAL PROD	8	-	8	-	-	-	-	-
3315 IRON, STEEL SHAPES, ETC SHEET	3,555	3,555	-	-	-	-	-	-
3316 IRON AND STEEL PLATES, SHEETS	6,224	-	-	-	-	5,600	624	-
3317 IRON AND STEEL PIPE AND TUBE	6,572	6,445	127	-	-	-	-	-
3321 NONFERROUS METALS, NEC	440	5	435	-	-	-	-	-
3324 ALUMINUM AND ALLOYS, UNWORKED	643	7	636	-	-	-	-	-
3411 FABRICATED METAL PRODUCTS	926	290	18	150	-	-	468	-
3511 MACHINERY, EXCEPT ELECTRICAL	3,353	30	1,723	-	-	1,600	-	-
3611 ELECTRICAL MACH AND EQUIP	140	24	116	-	-	-	-	-
3711 MOTOR VEHICLES, PARTS, EQUIP	2,473	2,351	122	-	-	-	-	-
3731 SHIPS AND BOATS	6,171	16	5,258	-	897	-	-	-
3791 MISC TRANSPORTATION EQUIPMENT	11	-	11	-	-	-	-	-
3811 INSTR, TIME, PHOTO, OPT GOODS	5	3	2	-	-	-	-	-
3911 MISC MANUFACTURED PRODUCTS	5,389	7	-	-	-	1,709	3,673	-
4029 WASTE AND SCRAP, NEC	11,555	-	-	-	-	-	11,555	-
4112 COMMODITIES, NEC	49	1	28	-	-	20	-	-
9999 DEPARTMENT OF DEFENSE AND SCI	581	-	581	-	-	-	-	-

TOTAL TON-MILES, 184,436,151.

TABLE 6

HISTORICAL SHIPMENTS - PASCAGOULA INNER HARBOR AND BAYOU CASOTTE CHANNELS[a]

(1,000 short tons)

		Foreign		Domestic				
				Coastwise		Internal		
	Total	Imports	Exports	Receipts	Shipments	Receipts	Shipments	Local
1980	25,433.6	9,644.5	4,226.4	519.1	5,988.9	1,501.8	3,419.0	133.8
1981	26,362.6	11,431.3	2,758.0	1,229.7	5,729.8	1,616.6	3,451.8	143.3
1982	19,157.4	6,885.3	1,802.8	1,643.5	4,592.2	1,121.7	3,022.6	89.3
1983	20,327.7	10,576.4	775.5	737.4	3,733.5	852.6	3,586.2	66.0
1984	24,153.1	12,082.4	2,161.8	653.7	4,542.7	992.3	3,644.2	76.1
1985	20,006.4	8,277.8	2,500.8	295.7	4,089.5	1,187.9	3,530.6	124.0
1986	23,699.9	11,870.9	2,976.0	58.0	4,295.2	982.8	3,488.3	28.7
1987	27,824.8	14,446.2	3,003.3	59.7	5,139.6	1,018.7	4,115.6	21.6
1988[a]	29,059.2	-	-	-	-	-	-	-

[a]Port records

TABLE 7
1987 WATERBORNE COMMERCE, BAYOU CASOTTE INNER HARBOR CHANNEL

FREIGHT TRAFFIC, 1987

(SHORT TONS)

COMMODITY	TOTAL	FOREIGN IMPORTS	FOREIGN EXPORTS	DOMESTIC COASTWISE RECEIPTS	DOMESTIC COASTWISE SHIPMENTS	DOMESTIC INTERNAL RECEIPTS	DOMESTIC INTERNAL SHIPMENTS	LOCAL
TOTAL	26,007,671	14,367,087	1,882,069	59,562	5,130,767	666,368	3,890,081	17,625
01 COTTON, RAW	20	-	20	-	-	-	-	-
03 CORN	52,673	-	52,673	-	-	-	-	-
06 SORGHUM GRAINS	36,580	-	36,580	-	-	-	-	-
07 WHEAT	16,703	-	-	-	-	16,703	-	-
11 SOYBEANS	27,071	-	27,071	-	-	-	-	-
19 OILSEEDS, NEC	625	-	625	-	-	-	-	-
29 FIELD CROPS, NEC	21	21	-	-	-	-	-	-
61 CRUDE RUBBER AND ALLIED GUMS	62,225	62,225	-	-	-	-	-	-
31 MARINE SHELLS, UNMANUFACTURED	22,000	-	-	-	-	22,000	-	-
11 CRUDE PETROLEUM	14,223,567	14,223,567	-	-	-	-	-	-
42 SAND, GRAVEL, CRUSHED ROCK	20	20	-	-	-	-	-	-
51 CLAY	636	-	636	-	-	-	-	-
71 PHOSPHATE ROCK	41,907	-	5,409	36,500	-	-	-	-
93 SULPHUR, LIQUID	260,456	-	-	-	194,836	2,910	62,710	-
94 GYPSUM, CRUDE AND PLASTERS	32,143	-	-	-	-	-	32,143	-
12 MEAT AND PRODUCTS, NEC	20	20	-	-	-	-	-	-
15 ANIMAL BYPRODUCTS, NEC	20	20	-	-	-	-	-	-
41 WHEAT FLOUR AND SEMOLINA	1,096	-	1,096	-	-	-	-	-
99 MISCELLANEOUS FOOD PRODUCTS	6,126	34	6,092	-	-	-	-	-
11 BASIC TEXTILE PRODUCTS	100	98	2	-	-	-	-	-
11 APPAREL	102	47	55	-	-	-	-	-
21 LUMBER	1,048	1,048	-	-	-	-	-	-
31 VENEER, PLYWOOD, WORKED WOOD	12	12	-	-	-	-	-	-
91 WOOD MANUFACTURES, NEC	22	22	-	-	-	-	-	-
11 PULP	46,552	-	46,552	-	-	-	-	-
21 STANDARD NEWSPRINT PAPER	21,218	21,218	-	-	-	-	-	-
31 PAPER AND PAPERBOARD	5,072	5,072	-	-	-	-	-	-
18 SODIUM HYDROXIDE	9,996	-	-	-	-	9,996	-	-
11 CRUDE TAR, OIL, GAS PRODUCTS	3,006	-	-	-	-	3,006	-	-
17 BENZENE AND TOLUENE	131,485	-	-	-	-	116,474	15,011	-
18 SULPHURIC ACID	239,008	-	-	-	-	120,773	118,235	-
19 BASIC CHEMICALS AND PROD, NEC	265,242	13,200	96,060	-	6,561	40,701	109,832	-
21 PLASTIC MATERIALS	1	-	1	-	-	-	-	-
51 PAINTS	659	659	-	-	-	-	-	-
71 NITROGENOUS CHEM FERTILIZERS	24,507	-	-	-	-	5,000	19,507	-
72 POTASSIC CHEM FERTILIZERS	46,125	-	-	-	-	38,939	7,186	-
73 PHOSPHATIC CHEM FERTILIZERS	1,360	-	-	-	-	1,360	-	-
76 INSECTICIDES, DISINFECTANTS	101	97	4	-	-	-	-	-
79 FERTILIZER AND MATERIALS, NEC	96,356	-	-	-	-	7,157	82,100	7,099
91 MISCELLANEOUS CHEMICAL PROD	26	-	26	-	-	-	-	-
11 GASOLINE	3,820,000	-	85,019	1,002	2,511,097	68,619	1,152,003	-
12 JET FUEL	1,126,619	-	86,306	-	803,559	-	236,754	-
10 DISTILLATE FUEL OIL	1,948,004	-	130,553	-	1,205,264	65,369	536,292	10,526
15 RESIDUAL FUEL OIL	569,163	27,900	-	20,020	227,262	52,036	241,833	-
16 LUBRICATING OILS AND GREASES	25,605	-	9,001	-	-	-	16,604	-
17 NAPHTHA, PETROLEUM SOLVENTS	75,010	-	-	-	-	15,528	59,482	-
18 ASPHALT, TAR, AND PITCHES	717,163	-	-	-	6,796	-	710,367	-
19 COKE, PETROLEUM COAL	1,315,896	-	1,282,038	-	-	-	33,858	-
21 LIQUEFIED GASES	380,986	-	-	1,024	165,612	53,994	160,356	-
21 PETROLEUM AND COAL PROD, NEC	293,415	-	37245	-	-	21,755	234,415	-
11 RUBBER AND MISC PLASTIC PROD	52	45	7	-	-	-	-	-
15 IRON, STEEL SHAPES, EXC SHEET	3,555	3,555	-	-	-	-	-	-
17 IRON AND STEEL PIPE AND TUBE	6,572	6,445	127	-	-	-	-	-
11 NONFERROUS METALS, NEC	640	5	635	-	-	-	-	-
10 ALUMINUM AND ALLOYS, UNWORKED	643	9	634	-	-	-	-	-
11 FABRICATED METAL PRODUCTS	46	45	1	-	-	-	-	-
11 MACHINERY, EXCEPT ELECTRICAL	1,038	27	1,011	-	-	-	-	-
ELECTRICAL MACH AND EQUIP	110	20	90	-	-	-	-	-
MOTOR VEHICLES, PARTS, EQUIP	2,396	2,351	45	-	-	-	-	-
11 SHIPS AND BOATS	107	16	91	-	-	-	-	-
11 INSTR, TIME, PHOTO, OPT GOODS	5	3	2	-	-	-	-	-
10 WASTE AND SCRAP, NEC	11,555	-	-	-	-	-	11,555	-
12 COMMODITIES, NEC	15	-	15	-	-	-	-	-
10 DEPARTMENT OF DEFENSE AND SCI	581	-	581	-	-	-	-	-

TOTAL TON-MILES. 121,672,668.

TABLE 8

HISTORICAL SHIPMENTS - BAYOU CASOTTE INNER HARBOR CHANNEL[a]

		Foreign		Domestic				
				Coastwise		Internal		
	Total	Imports	Exports	Receipts	Shipments	Receipts	Shipments	Local
1980	20,970.1	9,567.5	766.8	518.9	5,949.1	685.0	5,352.6	129.8
1981	23,508.2	11,388.1	741.6	1,190.2	5,665.4	1,001.0	3,376.6	144.3
1982	17,469.1	6,884.4	707.4	1,611.8	4,582.5	676.4	2,917.7	88.9
1983	19,492.9	10,572.5	368.5	737.4	3,708.4	566.2	3,473.9	66.0
1984	22,718.9	12,049.6	1,195.6	652.9	4,542.2	633.9	3,569.4	75.4
1985	18,117.7	8,250.1	1,243.5	295.7	4,088.9	729.5	3,386.0	124.0
1986	22,100.8	11,834.1	1,936.5	57.6	4,279.0	636.8	3,328.1	28.7
1987	26,007.5	14,367.8	1,882.9	59.6	5,138.8	646.4	3,890.4	21.6
1988[a]	28,345.6	14,185.2	-	-	-	-	-	-

[a]Port records

TABLE 9
1987 SUMMARY OF COMMERCE FOR BOTH CHANNELS

PRODUCT	VOLUME (Million Short Tons)	PERCENT (%)
Petroleum (import)	14.2	51
leum Coke (export)	1.3	5
Petroleum Products		
astwise/internal)	10.3	38
(export)	1.2	4
cals (export)	.4	1
(import/export)	.4	1
	27.8	100%

draft vessels used in transporting bulk commodities such as lizer, phosphate rock, petroleum products, chemicals, lumber reak bulk commerce are tankers, dry bulk carriers, ocean s, and general cargo ships loaded to drafts that could be modated by the present 38 foot channel depth. These ges total 11.1 million tons in Table 9. Commodities moving ese deep-draft vessels were excluded from the benefit sis herein. It is expected these commodities will continue ve in ships requiring 38 feet or less in the future. The nder of the tonnage was used in the benefit analysis.

TONNAGES

General. Each commodity using the port will be analyzed for tonnage which will be using the channels for the three tions previously discussed on page 7. All three conditions be addressed consecutively by commodity.

Grain (export). Exported bulk grain has been the major dity which fully utilizes the Pascagoula Inner Harbor el.

. Existing Tonnage. Historical bulk grain exports through ublic grain elevator leased by Louis Dreyfus Corporation on channel are shown in Table 10. The highest level of ted bulk grain was in 1979 (over 3.8 million tons). By the Russian grain embargo by the U.S. caused drastic es in foreign markets for this company which as a result, med out in 1983. In September, 1982, a bagging operation tarted to hedge against the lost bulk markets and was used g 5.5 percent of the total export tonnage for years 1983 to The extreme drought in 1988 caused transportation costs the Midwest by barge on the Mississippi River to rise tically (rail transportation costs also increased taneously), and Louis Dreyfus Corporation committed 25 nt of elevator capacity to the bagged grain operation in

Table 10
BULK GRAIN EXPORTS, PASCAGOULA INNER HARBOR CHANNEL[9]
1979-1989

Year	Total Exported Bulk grain (short tons)
1979	3,832,073
1980	3,533,763
1981	2,087,670
1982	1,147,908
1983	377,156
1984	986,927
1985	1,113,361
1986	1,039,183
1987	1,178,905
1988	381,193[a]
1989 (estimate 11/89)	807,500[a]

[a]Company records.

early 1988 since the U.S. government was subsidizing bagged grain to third world countries. As a result, elevator space at Mobile Harbor was rented and 168,000 short tons of bulk grain was shipped through Mobile Harbor in 1988 instead of through Pascagoula. Since this bagging operation is a year-to-year commitment and can be stopped immediately, the company felt that this should not decrease their potential to get foreign export bulk grain contracts.

b. Without-Project Condition Tonnage. Company officials forecast that pre-Russian grain embargo trade levels (3.8 million tons) can be re-established for Pascagoula even with the formation of the European Economic Community (EEC), since France may not produce enough grain (corn, wheat and soybeans) to fulfill the needs of all Europe. Louis Dreyfus Corporation predicts that their future trade levels with Spain and Portugal may not be as high as 1979 levels; however, these markets could easily be replaced with new Far East markets, such as China.

Three sources of projections of U.S. bulk grain exports were examined (Drewry's[10], DRI/Temple Barker and Sloane, Inc.[11] and USDA/Economic Research Services[12]). Neither of the first two sources offered projections beyond 1993 due to the politically sensitive nature of U.S. grain exports (changes in EEC, China, Russia, etc.) Drewry's showed a negative growth over the period 1987-1992; and DRI showed a 0.5 percent annual compound growth rate over the period 1988-1993.

c. The USDA/ERS predicted that U.S. grain exports would grow at a compound rate of 2.23 percent per year during the period

1990-1995 and only .39 percent for the next 25 years (1996-2020)[13], which will be caused by a projected weakened U.S. economy and stronger exporter nations such as Argentina. See Table 11. The new Russian grain agreement with the U.S. which was signed late October, 1989 gives the Russians blanket permission to increase their U.S. imports within a 5.0 to 14.0 million metric ton range (source: Louis Dreyfus Corporation and Agricultural Outlook, January-February, 1990). Since approximately 50 percent of U.S. exports are from Lower Mississippi and gulf ports east of the Mississippi (most of the Russian sales are from the Lower Mississippi ports), this analysis assumed that the Pascagoula Inner Harbor channel would maintain its market share and would grow at the same U.S. rate based on Pascagoula's export grain mix (see Table 12). Then, Pascagoula grain exports will grow at a compound rate of 2.48 percent annually during the period 1990-1995 and a meager 0.45 percent for the next 25 years (1996-2020). No growth was projected after 2020.

A fourth source (Wharton Econometric Forecasting Associates, or "WEPA", pamphlets 3 and 4 for September and December, 1989 and their Executive Summaries for January and February, 1990) was examined for possible changes in the projections above. WEPA projections were short-term (1990-1992) and showed stronger corn exports to Russia, moderately strong wheat exports to China and slightly weaker soybean exports in general. In general, the WEPA projections offered no major changes to the projections by USDA shown in the previous paragraph.

d. The latest Waterborne Commerce data were used for the nine year period 1979-1987 (see Table 10 again), and bulk grain exports from Pascagoula were averaged (1,742,015 tons). These export grain tonnages must be adjusted for shipments to foreign destinations which have channel depths of 38-feet or less and/or shiploads of 38-feet or less, which accounted for 46 percent of the total tonnage in this analysis (see the 1984 Feasibility Report[14]). Base year (1995) tonnage is computed by multiplying 1,742,015 tons by 54 percent and the resultant answer by 1.13, which is the growth rate factor associated with a 2.48 compound growth rate for five years (1990-1995). The results are 1,063,300 tons of exported bulk grain for the first year the proposed project is expected to be operational (base year). Compound growth factors were used to compute tonnages for selected years of the remainder of the without-project period.

e. With-Project Tonnage. The exported bulk grain tonnage for this condition is the same as for the without-project condition.

25. Crude Oil (import). Chevron, U.S.A. Inc. operates the 300,000 barrels/day capacity refinery (47,162 short tons) on the Bayou Casotte Inner Harbor channel; and continues to operate

TABLE 11

USDA PROJECTIONS OF GROWTH IN U.S. GRAIN EXPORTS

(Millions of Metric Tons)[15]

	1990/91	1995/96		2020/21	
		Compound Annual		Compound Annual	
	Tons	Tons	Growth (1990-1995)	Tons	Growth (1996-2020)
Wheat	40.1	45.6	2.60%	49.0	0.29%
Corn/Sorghum	62.0	67.0	1.56%	74.0	.40%
Soybeans	19.0	22.6	3.53%	25.9	.55%
Totals	121.1	135.2	2.23%	148.9	.39%

TABLE 12

WEIGHTED ANNUAL COMPOUND GROWTH RATE FOR GRAIN EXPORTS AT PASCAGOULA

	Percent	Compound Growth Rates			
		1990-1995		2020/21	
	Pascagoula Export Mix[a]	U.S. Actual	Pascagoula Weighted	U.S. Actual	Pascagoula Weighted
Wheat	.11	2.60	.29[b]	.29	.03[b]
Corn/Sorghum	.48	1.56	.75	.40	.19
Soybeans	.41	3.53	1.45	.55	.22
Totals	1.00		2.48		.45

[a]Average of 1979-1987 waterborne commerce

[b].11 x 2.60 = .29, or, .11 x .29 = .03

Note: Totals may not sum due to rounding.

shuttle tankers ("lighters") to/from a mother ship located 25 miles offshore to their refinery. However, the proposed new 80,000 dwt lighters cited in the Feasibility Report[16] were placed in operation in June and October 1988 with improved crude loading rates (80,000 barrels per hour) and crude discharge rates (60,000 barrels per hour). Plant intake lines were also modified to accommodate the efficient discharge rate of the new vessels. Turnaround time per lighter trip was reduced to 36 hours each with these improvements, excluding delays in the channel.

a. This refinery can simultaneously use both light and heavy crude (origins of the crude are currently Mexico and Saudi Arabia) which are processed through two 150,000 barrels per day crude processing units. Plant capacity, then, is 300 thousand barrels per day (MB/D). This equates to 17,246,250 short tons annually at full production **using an average of 315 pounds per barrel** (315 pounds per barrel x 300,000 x 365/2,000). **This tonnage can increase with the density of the heavier crude, which weighs an average of 325 pounds per barrel; therefore, the annual tonnage can approach 18.0 million short tons annually. For simplicity, this analysis used maximum capacity with the lighest density of crude (315 pounds).**

b. Existing Tonnage. Imported crude tonnages reported in Table 13 show that the lightering operations did not reach near capacity until 1989. **Numerous reasons (continual channel shoaling, testing the new lighters, failure of the coker at Chevron, etc.) have prevented the refinery from reaching capacity of the foreign imports. Recent production (barrels of crude) were furnished by Chevron in February, 1992 to MDO personnel who converted them to short tons based on 315 pounds/barrel. Domestic crude from the Gulf of Mexico used in this refinery range from 1 to 2 percent of the total annual input based on Chevron records.**

TABLE 13

FOREIGN CRUDE IMPORTS AT BAYOU CASOTTE INNER HARBOR CHANNEL[17]

	(SHORT TONS)
1980	9,526,475
1981	11,151,481
1982	6,206,788
1983	10,280,724
1984	12,007,255
1985	8,219,163
1986	11,753,583
1987	14,223,567
1988	14,037,789[a]
1989	**16,747,605**[b]
1990	**16,040,588**[b]
1991	**17,160,255**[b]

[a]From port records; [b]**From Chevron records, February, 1992.**

c. Without-Project Condition Tonnage. **Company officials are confident** that plant capacity will be reached by 1995 and sustained thereafter; therefore, 17,246,250 tons were accepted as base year tonnage. No expansion of this plant is expected over the without-project period (1996-2046) based on data from company officials for two reasons: (a) there is an oversupply of U.S. crude oil refinery capacity; and (b) environmental constraints will preclude expansion of the existing facilities. Crude delivered by their lightering operations has been steadily growing; capacity will be reached by 1996 and is expected to be maintained over the without-project period. **Minor amounts of domestic crude inputs will be used by this refinery; however, the plant will rely on foreign imports. The annual use of domestic crude is less than one lighter load and would not affect the outcome of this project feasibility analysis.**

d. With-Project Condition Tonnage. These tonnages will not change from without-project condition.

26. Petroleum Coke (export). Chevron, U.S.A. Inc., produces numerous products. Petroleum coke is a by-product of the heavy crude, and production rates vary with the type and volume of crude processed. Table 14 displays the historical exports of this product.

a. Existing Tonnage. The average daily production rate is 4,000 short tons or 1,460,000 short tons annually. Annual production was exceeded in 1986 and 1989. Storage space dockside is 112,000 short tons; modern dockside loading equipment operates at 1,120 short tons per hour. See Figure 3 for location of the coke dock. All of this tonnage is sold F.O.B. the vessel at the coke pier to SSM Carbon, Inc., a U.S. broker, who delivers the product to European ports.

TABLE 14
PETROLEUM COKE EXPORTS AT BAYOU CASOTTE INNER HARBOR CHANNEL[18] **(SHORT TONS)**

1980	0
1981	0
1982	0
1983	88,246
1984	799,184
1985	814,825
1986	1,429,396
1987	1,282,438
1988	1,384,589[a]
1989	1,545,834[a]

[a]From port records

b. Without-Project Condition Tonnage. Based on above mentioned crude oil refinery capacities/restrictions, no growth is expected for this product over the 1996-2046 period. Based on data from Chevron, only 75 percent of the tonnage would benefit from a deeper channel (the other 25 percent would be restricted by depths at foreign ports and coke dust problems requiring a smaller or partial shipload). Typical foreign destinations with 38-foot channels or less were Gela, Italy and Cadiz, Valencia and Malaga, Spain. Those destinations with greater than 38 feet were Fos and LeHarve, France, Ghent and Antwerp, Belgium and Rotterdam, Netherlands. The plant has maintained production rates of coke since 1986 and is expected to continue under the without-project period. For base year then, 1,095,000 tons of coke will be transported in vessels needing greater than a 38-foot channel (1,460,000 x .75). No growth in this tonnage will occur over the remainder of the without-project period.

c. With-Project Tonnage. This tonnage will also remain the same as the without-project condition period.

27. Summary of Tonnages. Table 15 summarizes the base year and without-project condition tonnages of commerce which will be transported in deep-draft vessels needing channel depths greater than 38 feet. These tonnages are also the tonnages for with-project condition(s). Approximately 19 million tons of commerce will utilize greater channel depth on the two channels over the period 1996-2046.

TABLE 15
WITHOUT-PROJECT CONDITION PROJECTIONS OF COMMERCE
PASCAGOULA HARBOR
(1 October 1991 Prices)

	1,000 SHORT TONS					
	1996	2006	2016	2026	2036	2046
BAYOU CASOTTE:						
Crude Oil (import)	17,246.5	17,246.5	17,246.5	17,246.5	17,246.5	17,246.5
Petroleum Coke (export)	1,095.0	1,095.0	1,095.0	1,095.0	1,095.0	1,095.0
Subtotal	18,341.5	18,341.5	18,341.5	18,341.5	18,341.5	18,341.5
PASCAGOULA RIVER:						
Bulk Grain (export)	1,063.3	1,112.1	1,163.2	1,189.6	1,189.6	1,189.6
TOTAL	19,404.8	19,453.6	19,504.7	19,531.1	19,531.1	19,531.1

Note: Totals may not sum due to rounding.

VESSEL TRAFFIC, CHARACTERISTICS AND COSTS

28. General. Plates 2 and 3 pictorially describe the terminals/piers at each port. Table 16 describes the usage of each pier (product, number of trips annually, general vessel type, dimensions and underkeel clearances required by each type of vessel, etc.).

29. Existing Vessel Traffic, Characteristics and Costs. The operational characteristics of the existing fleet are also shown on Table 16. The operational draft of lash vessels carrying rubber into Bayou Casotte will not exceed 36 feet based on company data. Three products fully utilize the existing 38-foot channel--crude oil and petroleum coke on the Bayou Casotte Inner Harbor channel and bulk grain on the Pascagoula Inner Harbor channel.

30. Table 17 shows the distribution of all vessels calling at Pascagoula Harbor in 1987 by their types and drafts for both channels based on Waterborne Commerce data. The table shows the two channels separately. The inbound crude tankers at Bayou Casotte are the largest group of deep-draft vessels utilizing 36+ feet of draft. The outbound dry bulk carriers carrying grain and coke are the next largest group of vessels utilizing 36+ feet of draft.

31. Without-Project Vessel Traffic, Characteristics and Costs. Commodities and vessel patterns for 1996 and without-project condition (1996-2046) were analyzed for the commodities which would utilize channel depths greater than 38 feet. These commodities and vessel characteristics are shown in Table 18 along with other pertinent cost data. Vessel operating costs were based on FY 1991 price levels and were obtained from Economic Guidance Memorandum 91-4, dated 6 March 1991 except for the lighters because of the unique design of these vessels. Operating costs are in terms of cost per hour for the operation of the vessels at sea and in port. Hourly operating costs from Table 18 were applied to varying vessel operating procedures to determine net transportation costs per ton. Consideration was given to such factors as distance of haul, speed of vessel, vessel size(dwt), amount of backhaul, and the allowable load of cargo under varying channel depths at Pascagoula. Times in port were based upon port officials data, furnished by the Office of Chief of Engineers (OCE), Temple, Barker and Sloane (TBS) data or company officials. Other costs developed for this study included consideration of accessory charges (port, vessel, and handling) at Pascagoula and at alternative ports.

TABLE 16
EXISTING FLEET AND OPERATIONAL PATTERNS
(TYPICAL VESSELS)

Commodity	Vessel Type	Average dwt	Average Dimensions	Trips per year	Operational Draft	Average Underkeel Clearance (ft)	Terminal or Pier (ft)
Pascagoula Inner Harbor Channel							
Grain:							
a) bagged	general cargo	20,000	400 x 80 x 34	28	30-34	0	Terminal A
b) bulk	dry bulk carrier	45,000	690 x 100 x 38	30	38	0	Grain Elevator
Lumber/wood products	general cargo	30,000	450 x 95 x 34	10	28-34	0	Terminals B & C
Rubber	RoRo	28,300	860 x 106 x 39	3	34	2	Terminal B
Frozen Foods	general cargo	15,000	350 x 85 x 32	4	26-32	0	Terminal C
Bayou Casotte Inner Harbor Channel							
Crude Oil	tanker	78,656	785 x 122 x 40	218	36	2	Piers 6 & 7
Petroleum Coke	dry bulk carrier	50,000	750 x 105 x 40	35	34-36	2 to 4[a]	Coke Pier
Rubber	Lash	28,600	893 x 100 x 41	9	34-36	2	Terminals E & F
	RoRo	21,700	750 x 106 x 36	5	30-34	2	Terminals E & G
Petroleum Products	tanker	35,000	650 x 96 x 37	120	28-36	2	Piers 3 and 5[b]
	ocean barge	30,000	400 x 85 x 30	120	28-34	2	Piers 3 and 5[b]
Chemicals	tanker	20,000	400 x 80 x 29	5	24-30	2	Terminal G
Fertilizers:							
a) Phosphate (rock/DAP[c])	dry bulk carrier	25,000	550 x 85 x 35	36	28-32	2	NuSouth Pier
b) Ammonia	tanker	20,000	650 x 100 x 36	24	25-30	2	NuSouth Pier
Other	general cargo	15,000	400 x 85 x 30	5	20-30	0	Terminals E-H

[a] These vessels are restricted draft-wise by the operational pattern of the crude tankers.
[b] Piers 1, 2 and 4 are used by inland barges loading/discharging Chevron products (300 inbound, 1850 outbound plus 1550 towboats)
[c] "DAP" = diamonium phosphate (granular)

TABLE 17
DISTRIBUTION OF VESSELS CALLING AT PASCAGOULA INNER HARBOR AND BAYOU CASOTTE CHANNELS BY TYPE AND DRAFT, 1986

TRIPS AND DRAFTS OF VESSELS

HARBOR OR WATERWAY	DIRECTION						DIRECTION					
	SELF PROPELLED VESSELS			NON-SELF PROPELLED VESSELS		TOTAL	SELF PROPELLED VESSELS			NON SELF PROPELLED VESSELS		TOTAL
DRAFT (FEET)	PASSENGER AND DRY CARGO	TANKER	TOWBOAT OR TUGBOAT	DRY CARGO	TANKER		PASSENGER AND DRY CARGO	TANKER	TOWBOAT OR TUGBOAT	DRY CARGO	TANKER	
PASCAGOULA HARBOR, MISS.			INBOUND						OUTBOUND			
38							1					1
37		8				8	6	2				8
36		210				210	22	6				28
35	1	2				3	10	5				15
34	2	4				6	9	21				30
33	1	1				2	9	10			12	30
32	2	1				3	7	7			41	55
31	5	2				7	2				1	3
30	1	2			3	6	7	7				14
29	2	2				4	3				19	22
28	4	1				5	13	3			14	30
27	3	5				8	4	13				17
26	4	9				13	4	212			1	217
25	9	5				14	7	6				13
24	13	5				18	5	1			1	7
23	7	7				14	3	4				7
22	8	6	20			34	7	3	21			31
21	16	16		1		33	6	2		1	1	10
20	13	2	21			36	13	3	21	1	2	40
19	11	20				31	5	1				6
18 AND LESS	1,163	6	1,427	733	1,881	5,210	1,132	1	1,425	733	1,791	5,072
TOTAL	1,265	310	1,468	734	1,884	5,665	1,205	315	1,467	735	1,881	5,665
BAYOU CASOTTE, MISS.			INBOUND						OUTBOUND			
37		8				8	6	2				8
36		210				210	13	6				19
35	1	2				3	4	3				7
34	1	4				5	6	21				27
33		1				1	5	10			12	36
32	1	1				2	1	7			41	49
31	1	2				3	1				1	2
30	1	2			3	6	5	7				12
29		2				2	2				19	21
28	3	1				4	3	3			14	20
27	2	4				6	3	13				16
26	3	9				12	1	211			1	213
25	7	5				12	3	6				9
24	10	3				13	1	1			1	3
23	3	7				10	1	4				5
22	3	5	20			28	3	1	21			25
21	11	15				26	5	2				7
20	4	2	21			27	3	3	21		2	29
19	7	19				26	2					2
18 AND LESS	17	6	1,211	160	1,866	3,258	6	2	1,210	159	1,775	3,152
TOTAL	75	308	1,252	160	1,867	3,662	76	310	1,252	159	1,866	3,661

32. A voyage constitutes a one-way movement from Pascagoula to the foreign port plus some part of the return trip to Pascagoula. In calculating at-sea costs, an allowance is made to reflect a partial empty return (backhaul). Dry bulk carriers do not operate fully loaded at all times. The dry bulk carrier shipping industry shows that these vessels operate about sixty percent of the time with cargo aboard (see the Feasibility Report on Pascagoula Harbor). The other forty percent of the time they are empty. To compensate for being loaded sixty percent of the time, an eighty percent empty backhaul was assigned to all dry bulk carriers transporting grain and petroleum coke to/from Pascagoula. To simplify the calculation of total voyage costs, a factor of 1.8 was applied to the one-way mileage.

33. Costs per ton (unit costs) were computed for vessels fully loaded and lightloaded using data from Table 18. The following computation illustrates the method used to determine voyage costs for the various movements considered. The unit costs were derived by dividing the total operating costs for a voyage for a particular vessel size by the volume of cargo that can be carried with increased channel depth.

Sample Computation

Type Vessel = Dry Bulk Carrier; Deadweight tons = 50,000 tons
Time in Port (origin and destination) = 140 hours
Payload capacity = 51,520; Maximum draft = 39 feet
Cost per hour = $651 at sea; $488 in port
Immersion factor = 1,799 tons per foot of immersion
One-way distance = 4,700 nautical miles
Time at sea=(4,700 nautical miles X 1.8)/14 knots= 604 hours
Cost per round trip = (651 x 604 hrs) + (488 x 140 hrs) = $461,524
Cost per ton lightloaded to 36 feet for a 39-foot channel:
$461,524 divided by [51,520 - (1,799 x 3)] = $10.00
Cost per ton fully loaded to 39 feet for a 39-foot channel:
$461,524 divided by 51,520 = $8.96

34. With-Project Vessel Traffic, Characteristics and Costs. The vessel characteristics would be the same for crude oil under with-project condition(s); however, sizes and costs of the vessels used for transporting grain and petroleum coke will probably increase. These increased sizes of vessels will be discussed in subsequent paragraphs.

TABLE 18

CHARACTERISTICS AND HOURLY OPERATING COSTS FOR FOREIGN FLAG, DEEP DRAFT VESSELS TRANSPORTING COMMERCE AT PASCAGOULA HARBOR WHICH NEED A 38+-FOOT CHANNEL

(WITHOUT-PROJECT CONDITION)

(1 OCTOBER 1991 PRICES)

Commodity	Kind	Average Size (dwt) (long tons)	Maximum Draft (feet)	Immersion Factor (short tons/foot)	Average Speed (Knots)	Payload Capacity[19] (Short tons)	Time In Port (Hrs)	Hourly Costs At Sea $	Hourly Costs In Port $
Crude (import)	Tanker	78,656	40	3,072.0[a]	14	85,050	22.8[b]	1,098[c]	1,098[c]
Petroleum Coke (export)	Dry Bulk Carrier	50,000	40	1,799.0	14	40,376[e]	98.4[d]	651	488
Grain (export)	Dry Bulk Carrier	45,000	38	1,660.1	14	36,207[f]	92.4[d]	623	467
Chemicals (export)	Tanker	35,000	36	1,236.0	14	32,000	20.0	771	628

[a]From 36 to 38 feet = 2,677 tons/ft; from 38 to 40 feet = 3,465 tons/ft (3,072 is the average).

[b]Hours to hook-up, load, discharge, bunker, unhook and turn (not necessarily in this order)

[c]Outcharter hourly earnings were used instead of Corps hourly rates due to the uniqueness of these vessels.

[d]1,120 short tons/hour is the loading rate for coke/coal and 2,385/hour for grain.

[e]Cargo capacity in cubic feet (47.6 short tons per cubic foot)

[f]Cargo capacity in cubic feet (47.54 short tons per cubic foot)

VESSEL FLEETS

35. General. The purpose of this portion of the analysis is to project fleet sizes for each commodity which will be assigned to each alternative channel depth based on the world distribution of each type of vessel and based on existing vessel operational patterns, such as underkeel clearances. Crude oil imports are expected to utilize the same size vessels over the life of the project. Petroleum coke exports and grain exports may utilize larger dry bulk carrier fleets under the with-project condition(s).

36. Existing Dry Bulk Carrier Fleet. Table 19 displays the world fleet by number of vessels in each class as of mid-1987 and active deadweight emerging in the largest sizes; and 64 percent of all single voyage charters are in 50,000+ dwt vessels from the U.S. Gulf/U.S. Atlantic[20]. This supports the act that ports along the Gulf are using the largest sizes of dry bulk carriers. Table 20 displays a more current fleet (source U.S. Maritime Administration) for only those drafts which might call at Pascagoula. Loading or discharging equipment at the harbor and/or channel width would restrict vessels to beams of 120 feet, which are vessels drafting 50 feet or less.

37. Without-Project Dry Bulk Carrier Fleet. Table 21 shows the projected growth in the world fleet from 1989 to 1992 based on data from Drewry Shipping Consultants, Ltd., in London.[21] The biggest decrease will occur in the 10,000 - 30,000 dwt class of vessels. A test was made in the percent change in weighted cost per ton to transport grain from Pascagoula to Rotterdam, Netherlands with the projected 1992 fleet and the existing fleet. The results produced no changes in costs per ton since the distribution of world deadweight tonnage did not change for vessels drafting 38 to 47 feet. This minor difference in the two fleets is reflected in the demand for dry bulk carriers. Bulk grain used 13.8 percent of the world bulk fleet in 1988 and is projected to demand 12.3 percent in 1992.[22] (Iron ore and coal demand the largest share of dry bulk carriers--a combined 50 percent). Since bulk grain is the third greatest user of dry bulk carriers and the 30,000 to 80,000 dwt range of vessels decreased almost the same proportional amount by deadweight class, the existing fleet of vessels was used in this analysis.

TABLE 19
BULK CARRIER FLEET BY DWT SIZE AS OF MID-1987[21]

				Dry Bulk Carriers	
Size (1,000 dwt)	Trade Names	No.	% of Total No.	Active DWT[a] (millions dwt)	% of Active DWT
10 - 30	(small/handy)	2,209	47.4	47.1	23.4
30 - 50	(medium/handymax)	1,408	30.2	51.3	25.5
50 - 80	(Panamax)	710	15.3	45.7	22.7
80 - 100	(quasi-large)	47	1.0	4.5	2.2
100 - 150	(large/Cape)	195	4.2	29.0	14.4
150+	(very large bulk carrier/VLBC)	87	1.9	23.6	11.7
Total		4,656	100.0	201.2	100.0

[a]136 bulk carriers were inactive in mid-1987 for various reasons.

Note: Totals may not sum due to rounding.

TABLE 20
WORLD DRY BULK CARRIER FLEET (PARTIAL)
(1 January 1989)

DRAFT (FT)	DEADWEIGHT TONS 10,000 19,999	20,000 29,999	30,000 39,999	40,000 49,999	50,000 59,999	60,000 79,999	80,000 99,999	TOTAL NO VESSELS	FLEET DWT	AVERAGE DWT	CARGO CAPACITY SHORT TON ROUNDED
MODE =	17,000	24,000	34,500	41,500	53,500	74,500	82,700				
25	19	2						21	315,000	15,000	13,000
26	27	1						28	425,600	15,200	13,200
27	63							63	976,500	15,500	13,500
28	48	3						51	816,000	16,000	14,000
29	104	2						106	1,802,000	17,000	15,000
30	193	21	3			3		220	3,960,000	18,000	15,900
31	176	100	5					281	5,901,000	21,000	18,800
32	57	289	25					371	8,904,000	24,000	21,700
33	21	333	12	3				369	9,963,000	27,000	23,700
34	3	318	40	4		1		366	10,980,000	30,000	25,100
35		243	227	44	1			515	15,707,500	30,500	25,400
36		68	271	68	1			408	15,504,000	38,000	29,800
37		5	245	95		2	1	348	14,616,000	42,000	33,600
38		5	64	91	10			170	8,075,000	47,500	38,300
39			33	44	8	1		86	4,472,000	52,000	42,400
40		2	19	58	60	31		170	10,200,000	60,000	50,700
41		1	1	22	93	92	1	210	14,070,000	67,000	55,300
42				3	30	82	4	119	8,568,000	72,000	60,400
43		1	4	7	6	145	2	165	12,375,000	75,000	62,500
44					13	69	3	85	6,545,000	77,000	63,800
45		1			2	66	3	72	5,688,000	79,000	65,200
46						29	18	47	3,807,000	81,000	66,700
47					1	38	4	43	3,526,000	82,000	67,600
48						11	7	18	1,566,000	87,000	72,000
49						8	14	22	2,046,000	93,000	77,200
50							4	4	396,000	99,000	92,400
TOTAL VESSELS	711	1,395	949	439	225	578	61	4,358			

TABLE 21
PROJECTED GROWTH IN DRY BULK FLEET (1989-1992)
(Million dwt)

DWT	1989	1992	%Change
10-30,000	44.1	37.9	-14
30-50,000	51.2	49.5	-3
50-80,000	43.1	41.5	-4
80-100,000	4.0	3.9	-2
100-150,000	24.8	25.6	+3
150+	18.8	24.1	+28

38. With-Project Dry Bulk Carrier Fleet. The methodology for assigning specific drafts of vessels to alternative channel depths depends on underkeel clearance requirements and possibility of topping off at another port. Table 22 displays an example assignment of specific drafts of vessels to grain exports, which includes vessels fully loaded to 38 feet (no underkeel clearance) under the existing condition. Based on data from Louis Dreyfus Corporation, these vessels will continue to fully use deeper channel depths under the with-project conditions, i.e., no underkeel clearance. Typically, the industry behaves with an upper limit of five feet of lightloading as was established in the Feasibility Report[24] on this harbor in 1984. As seen in Table 22, all of the vessels which can fully load to the proposed channel depth are kept in the fleet including those with 38-foot drafts.

39. Specifically, for a 42-foot channel depth, vessels in the 38-foot to 42-foot class are fully loaded. Each successive additional foot of vessel draft causes each successive larger size of vessel to be lightloaded by that same amount; e.g., the 75,000 dwt vessel at a 43-foot maximum draft is lightloaded one foot on the 42-foot channel alternative; the 77,000 dwt vessel at a 44-foot maximum draft is, then, lightloaded two feet on a 42-foot channel; etc. The computations in Table 22 are provided as an example of export bulk grain from Pascagoula to Southern Europe.

40. The procedure for fleet selection for exported petroleum coke would be different. These vessels are restricted to a 2-foot underkeel clearance by Chevron under existing and without-project conditions in order to minimize delays from possible groundings of the coke vessels to their tanker lightering operations. Some of these larger vessels are topping off at other ports. Also, SSM Carbon, Inc., the U.S. broker of this coke to Europe, informed MDO that this particular product could all be sold to customers in Europe which have over 40 feet of depth. These two

requirements necessitate a slightly different fleet of vessels which would operate on each alternative channel depth. Table 23 displays the 2 feet of underkeel clearance for each size petroleum coke vessel by each channel deepening alternative. It should be noted that the fleets shown in Tables 22 and 23 will carry the grain and coke destined to ports with drafts greater than 38 feet--46 and 25 percents of grain and coke were excluded for foreign depths less than 38 feet (and coke dust).

TABLE 22
ASSIGNMENT OF FLEETS OF VESSELS TO EACH CHANNEL DEPTH

WEIGHTED COSTS/TON BY PROPOSED CHANNEL DEPTHS
(GRAIN, PASCAGOULA TO SOUTHERN EUROPE)

				38'		39'		40'		41'		42'		43'		44'	
AVERAGE DWT	DRAFT (FT)	NUMBER VESSELS IN WORLD	WORLD DWT	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $
47,500	38	170	8,075,000	0.14	12.81	0.13	12.81	0.12	12.81	0.11	12.81	0.10	12.81	0.10	12.81	0.10	12.81
52,000	39	86	4,472,000	0.08	12.73	0.07	12.13	0.06	12.13	0.06	12.13	0.06	12.13	0.06	12.13	0.06	12.13
60,000	40	170	10,200,000	0.18	12.02	0.16	11.52	0.15	11.05	0.14	11.05	0.13	11.05	0.13	11.05	0.13	11.05
67,000	41	210	14,070,000	0.24	12.25	0.22	11.72	0.20	11.23	0.19	10.78	0.18	10.78	0.18	10.78	0.17	10.78
72,000	42	119	8,568,000	0.15	12.21	0.13	11.68	0.12	11.19	0.12	10.74	0.11	10.33	0.11	10.33	0.11	10.33
75,000	43	165	12,375,000	0.21	12.67	0.19	12.10	0.18	11.57	0.17	11.09	0.16	10.65	0.16	10.24	0.15	10.24
77,000	44	85	6,545,000			0.10	12.62	0.09	12.04	0.09	11.52	0.08	11.04	0.08	10.60	0.08	10.20
79,000	45	72	5,688,000					0.08	12.54	0.08	11.98	0.07	11.46	0.07	10.98	0.07	10.55
81,000	46	47	3,807,000							0.05	12.44	0.05	11.88	0.05	11.37	0.05	10.90
82,000	47	43	3,526,000									0.05	12.36	0.04	11.81	0.04	11.30
87,000	48	18	1,566,000											0.02	12.00	0.02	11.47
93,000	49	22	2,046,000													0.03	11.64
			TOTALS	1.00	12.41	1.00	12.01	1.00	11.68	1.00	11.41	1.00	11.23	1.00	11.06	1.00	10.96

Note: Totals may not sum due to rounding.

TABLE 23
ASSIGNMENT OF FLEETS OF VESSELS TO EACH CHANNEL DEPTH

WEIGHTED COSTS/TON BY PROPOSED CHANNEL DEPTHS
(PETROLEUM COKE, PASCAGOULA TO NORTHERN EUROPE)

				38'		39'		40'		41'		42'		43'		44'	
AVERAGE DWT	DRAFT (FT)	NUMBER VESSELS IN WORLD	WORLD DWT	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $	WEIGHTS %	COSTS $
38,000	36	408	15,504,000	0.23	16.46												
42,000	37	348	14,616,000	0.22	16.24	0.24	15.48										
47,500	38	170	8,075,000	0.12	15.88	0.13	15.13	0.14	14.45								
52,000	39	86	4,472,000	0.07	15.71	0.07	14.97	0.08	14.29	0.08	13.67						
60,000	40	170	10,200,000	0.15	14.81	0.17	13.13	0.18	13.51	0.18	12.95	0.18	12.43				
67,000	41	210	14,070,000	0.21	15.12	0.23	14.40	0.24	13.75	0.25	13.15	0.24	12.61	0.28	12.10		
72,000	42	119	8,568,000			0.14	14.34	0.15	13.69	0.15	13.09	0.15	12.55	0.17	12.04	0.21	11.58
75,000	43	165	12,375,000					0.21	14.20	0.22	13.55	0.22	12.96	0.24	12.42	0.31	11.93
77,000	44	85	6,545,000							0.12	14.13	0.11	13.49	0.13	12.98	0.16	12.37
79,000	45	72	5,688,000									0.10	14.04	0.11	13.41	0.14	12.83
81,000	46	47	3,807,000											0.07	13.92	0.09	13.29
82,000	47	43	3,526,000													0.09	13.82
			TOTALS	1.00	15.76	1.00	14.58	1.00	13.93	1.00	13.35	1.00	12.89	1.00	12.55	1.00	12.35

Note: Totals may not sum due to rounding.

ALTERNATIVE MODES AND UNIT COSTS

41. General. Various alternative modes of shipment were investigated to provide comparisons in evaluating transportation savings that would be realized from the proposed channel improvements at Pascagoula Harbor. Consideration was given to alternative routings, different vessel sizes, allowable cargoes, and offloading cargo at alternative ports in determining savings. The objective of this exercise is to verify that the commodities are moving at the cheapest alternative mode/rate under the existing condition.

42. Grain (export). Before addressing the question of alternative modes of inbound bulk grain into the Pascagoula Harbor grain elevator or their unit costs, the competitive viability of this elevator to other ports must be established. Competition is keen between the elevators at New Orleans and other surrounding ports such as Pascagoula and Mobile. Table 24 displays capacity and other operational characteristics of all the elevators on the Lower Mississippi; and it displays the same for Pascagoula and Mobile.

43. Table 25 shows a comparison of tonnages of exported bulk grain between Pascagoula, New Orleans and Mobile over the period 1978 to 1989. The purpose of the following analysis is to show whether the Pascagoula elevator is competitive with New Orleans and Mobile for attracting grain from the U.S. hinterland and exporting the grain to foreign markets.

44. Historical annual bulk exports from the three ports were analyzed for percentages which arrived by truck, rail and barge from comparable distances from the U.S. hinterland. Table 26 shows these percentages. Rates per short ton in Table 26 were furnished by Louis Dreyfus Corporation, the Pascagoula public grain elevator operator (lessee). It should be noted that Dreyfus also operates the Reserve elevator above New Orleans (See Table 24) and ships grain through Mobile when their Pascagoula bagging operations preclude bulk shipments. These rates were based on comparable hinterland locations for all three modes of transportation. The rail rate into Mobile includes an additional charge for switching to the Terminal Railroad (owned by the Alabama State Docks) from ICG or Burlington Northern. Further, the barge rate into Mobile (via Lower Mississippi and GIWW-E) has an additional $.69 per short ton ($.02 per bushel). Based on the weighted hinterland rates alone in Table 26, Mobile could be excluded from further analysis. New Orleans, though, has a $1.05 per ton advantage over Pascagoula in rail vs. rail rates and a $1.72 advantage in barge vs. barge rates. However, when rail rates at Pascagoula were compared to barge rates at New Orleans, the difference drops to a $.79/ton advantage for New Orleans.

TABLE 24

LOWER MISSISSIPPI GRAIN ELEVATOR CAPACITY (INCLUDING PASCAGOULA AND MOBILE)

(1 OCTOBER 1991 EVELOPMENT)

Elevator Name	River Mile	# Ships Loading Capacity	Elevator Storage Capacity (Million/Bu.)	Rail Unloading	Truck Unloading	Ship Loading Rate (S.T./hr)	Owners/Operators
Baton Rouge							
Port Allen	220	1	6.9	Yes	No	1,400	Cargill
Between Baton Rouge & New Orleans							
Convent[a]	160	1	4.0	Yes	Yes	4,000	ZenNoh
Paulina	150	1	2.0	Yes	Yes	1,500	Peavey
Terre Haute[b]	140	2	8.0	Yes	Yes	2,500	Cargill
Reserve	139	1	4.0	Yes	No	2,200	Louis Dreyfus Corp.
St. Charles	121	1	5.5	Yes	No	1,500	ADM/Garnac
Bunge	121	1	6.7	Yes	No	3,000	Bunge
Ama	120	1	5.8	Limited	No	2,500	ADM/Growmark
New Orleans							
Westwego[c]	103	2	6.0	Limited	No	3,000	Continental Grain
Myrtle Grove	57	1	6.0	No	No	2,500	Ferruzzi
Total			54.9				
Pascagoula	--	1	3.1	Yes	Yes	2,385	Louis Dreyfus Corp.[d]
Mobile	--	1	3.1	Yes	Yes	3,480	Alabama State Docks

[a]Built by the Japanese in 1982.

[b]Increased capacity was added in 1985 (2 ships loading simultaneously and 2 barges unloading simultaneously).

[c]Increased capacity was added in 1984 (2 ships loading simultaneously and 2 barges unloading simultaneously).

[d]This elevator is owned by the Jackson County Port Authority and is leased and operated by Louis Dreyfus Corporation. Numerous grain companies use this elevator; thus it is a public elevator.

TABLE 25
BULK GRAIN EXPORTS AT PASCAGOULA, NEW ORLEANS AND MOBILE[25]
(SHORT TONS)

	Pascagoula	% of N.O.	New Orleans	Mobile
1978	3,454,593	11.9	29,108,741	1,891,605
1979	3,832,073	13.0	29,590,495	1,306,251
1980	3,533,763	10.5	33,573,611	2,037,025
1981	2,087,670	5.8	36,221,765	1,771,215
1982	1,147,908	3.1	37,586,210	1,700,845
1983	377,156	1.2	31,346,788	667,349
1984	986,927[a]	3.6	27,635,706	699,398
1985	1,113,361[a]	4.6	24,421,036	1,173,017
1986	956,650[a]	4.6	20,716,369	2,005,958
1987	979,658[a]	3.4	28,428,756	1,894,684
1988	381,193[b]		N/A	595,862[b]
1989 (estimate)	807,500[b]		N/A	412,500[b]

[a] May not match Waterborne Commerce (bagged grain is excluded).
[b] Based on company records, November, 1989 (bagged grain is excluded).

TABLE 26
HINTERLAND RATES TO PASCAGOULA, NEW ORLEANS AND MOBILE - GRAIN
(1 October 1991 Prices)

	% Annual Tonnage	Rate Per Short Ton ($)	Weighted Rate Per Short Ton ($)
Pascagoula			
Truck	8.5	15.00[a]	1.28
Rail	56.2	10.44[b]	5.86
Barge	35.3	11.37[c]	4.01
	100.0		11.16
New Orleans			
Truck	0.5	15.00[d]	.08
Rail	5.0	9.39[e]	.47
Barge	94.5	9.65[f]	9.12
	100.0		9.66
Mobile			
Truck	11.0	15.00[g]	1.65
Rail	75.0	11.71[h]	8.78
Barge	14.0	12.06[i]	1.69
	100.0		12.12

[a]Within a 200 mile radius of Pascagoula;
[b]Terre Haute, Indiana (land-locked elevators via CSX Railroad);
[c]From Pekin, Henry or Chillicothe, Illinois via Lower Mississippi and GIWW-E;
[d]Within a 200 mile radius of New Orleans;
[e]Terre Haute, Indiana (land-locked elevators via ICG and Burlington Northern railroads);
[f]Same as footnote "c"; however, the barges stop at New Orleans
[g]Within a 200 mile radius of Mobile;
[h]Same as the rate to Pascagoula; however, it includes $1.27/short ton for using the Terminal Railroad at Alabama State Docks;
[i]Same as the rate to Pascagoula; however, it includes $.69/short ton for the extra distance from Pascagoula to Mobile via GIWW-E.

Note: Rates for barge and rail were furnished by Louis Dreyfus Corporation and are based on 1988/89 averages for 3 rail lines (CSX, ICG and Burlington Northern) and 1988/89 averages for several barge lines.

15. Two more rates must be considered before a determination can be made about competitiveness of a port--port charges and voyage costs. Port charges at New Orleans are considerably higher than at Pascagoula or Mobile (see Table 27). A 47,500 dwt dry bulk carrier (DBC) with a 38-foot load was compared at the three ports, along with a 71,700 dwt DBC with a 43-foot load at New Orleans and a 60,000 dwt DBC with a 40-foot load at Mobile. Both of these larger sizes of vessels at New Orleans and Mobile would fully utilize channel depths at each port. Table 27 is included for the purpose of showing the differences in methods of calculating port charges at each port and the magnitude of differences in costs. For instance, there were 3.5 days average vessel delay at New Orleans in 1989 and none at the other two ports. Port charges in this analysis are claimed for the U.S. port only; these charges at foreign ports were not readily available. Economies of scale occur in these calculations with larger vessels; or, on a unit basis, port charges slightly decrease with the larger sizes of vessels.

16. Export grain is destined to ten regions of the world (see Table 28) based on field data in the <u>Feasibility Report</u>. Voyage costs were computed from the entrance of each of the three ports (Pascagoula, New Orleans and Mobile) to the ten regions using: (a) the same percentage of tonnage to each region; (b) the same fleet selection for without-project condition (six classes of vessels or five feet of lightloading); And (c) the same backhaul rate. See Table 28. These voyage costs were first weighted by the world deadweight carrying capacity of each class of vessel to obtain a weighted cost per ton for each alternative channel depth (Tables 22 and 23). These costs were further weighted by their distribution of grain to each destination (region) in the world. In the first portion of Table 28, the combined voyage and port costs for the 38-foot channel at Pascagoula are $18.42. (Port charges in Table 28 will be slightly higher than those presented in Table 27--a port charge for a singular vessel is shown in Table 27; a <u>weighted fleet and weighted destination</u> port charge is shown in Table 28). The remainder of Table 28 shows these same costs for New Orleans (39 and 43-foot channels) and a 40-foot channel at Mobile. At the bottom of Table 28, the hinterland rates were added to the voyage costs and port charges to ascertain the total competitive picture of Pascagoula to the other two ports. Under the without-project condition, Pascagoula has a $.28 per ton cost advantage over New Orleans for grain moving at a 39 foot draft (Panama Canal limit), and a $1.04 per ton cost advantage over Mobile at 40 feet.

TABLE 27

COMPARISON OF GRAIN VESSELS AND PORT CHARGES AT PASCAGOULA, NEW ORLEANS AND MOBILE[26]

(1 October 1991 Prices)

	Pascagoula	New Orleans		Mobile	
Dry Bulk Carrier Size:	47,500 dwt	47,500 dwt	71,700 dwt	47,500 dwt	60,000 dwt
Loaded Draft:	38'	38'	43'	38'	40'
Gross Registered Tons (GRT)	32,000	32,000	40,000	32,000	40,400
Full Payload in Metric Tons	36,000	36,000	55,000	36,000	50,700
Length Overall (LOA)				681'	700'
	-------	-------	-------	-------	-------
Pilotage	$ 2,540	$ 8,500	$ 11,000	$ 3,000	$ 3,600
Tugs	4,500	9,000	9,000	7,400	10,300
Linehandlers	700	1,200	1,200	700	800
Harbor Fees	500	1,000	1,000	600	600
Dockage	8,960[a]	12,800[a]	16,000[a]	15,000	18,500
Stevedoring Charges	5,760[b]	14,400[b]	22,000[b]	9,000	12,700
Launch	0	1,000	1,000	0	0
Inspectors	1,500	2,000	2,000	1,500	1,700
Vessel Delays (at Anchorage)	0	36,960[c]	43,932[c]	0	0
Vessel Travel Time (in channel)	2,461[d]	29,534[d]	33,312[d]	8,900	9,500
Total Costs	$ 26,921	$ 116,394	$ 140,444	$46,100	$57,700
Costs per short ton	($. 68)	($2.93)	($2.32)	($1.16)	($1.03)

[a] 4 days at each port; $.07/GRT/day at Pascagoula and $.10 per GRT/day at New Orleans; $ (scale) per ft/LOA at Mobile;

[b] $.16/M.T. at Pascagoula; $.40/MT at New Orleans; $.25/MT at Mobile;

[c] 3.5 days is average delay at Anchorage at either $440 or $523/hour (in port costs/hour)

[d] 2 hours at Pascagoula (15 miles) X $615.3/hour at sea costs X 2 (roundtrip);
24 hours at New Orleans (133 miles = average of 10 elevators) X either $615.3 or $694/hour at sea costs X 2 (roundtrip); 30 miles at Mobile or 6 hours X either $615.3 or $660/hour X 2 (roundtrip).

FOREIGN DESTINATION (REGION)	TONNAGE	%	COST CATEGORY	Pascagoula 38' $ TON	Pascagoula 38' WEIGHTED COST/TON	Pascagoula 38' SUBTOTAL $/TON	New Orleans 39' $ TON	New Orleans 39' WEIGHTED COST/TON	New Orleans 39' SUBTOTAL $/TON	New Orleans 43' $ TON	New Orleans 43' WEIGHTED COST/TON	New Orleans 43' SUBTOTAL $/TON	Mobile 40' $ TON	Mobile 40' WEIGHTED COST/TON	Mobile 40' SUBTOTAL $/TON
Black Sea	80,251	8.30	Voyage	16.15	1.34		15.43	1.28		14.21	1.18		14.89	1.24	
(max depth 42 ft.)			Port	0.71	0.06	1.40	2.81	0.23	1.51	2.59	0.21	1.39	1.19	0.10	1.33
East Mediterranean	30,277	3.60	Voyage	15.50	0.56		14.81	0.53		13.31	0.48		14.30	0.51	
(max depth 43 ft.)			Port	0.71	0.03	0.58	2.81	0.10	0.63	2.53	0.09	0.57	1.19	0.04	0.56
West Mediterranean	35,000	3.30	Voyage	12.62	0.42		12.07	0.40		11.16	0.37		11.67	0.39	
(max depth 42 ft.)			Port	0.71	0.02	0.44	2.81	0.09	0.49	2.59	0.09	0.45	1.19	0.04	0.42
E Coast S America	34,024	3.20	Voyage	13.64	0.44		13.04	0.42		11.74	0.38		12.60	0.40	
(max depth 44 ft.)			Port	0.71	0.02	0.46	2.81	0.09	0.51	2.53	0.08	0.46	1.19	0.04	0.44
E Coast S America	53,163	5.00	Voyage	13.64	0.68		13.04	0.65		13.04	0.65		13.06	0.65	
(max depth 39 ft.)			Port	0.71	0.04	0.72	2.81	0.14	0.79	2.61	0.13	0.78	1.24	0.06	0.72
North Europe	125,465	11.00	Voyage	13.23	1.56		12.65	1.49		11.40	1.35		12.22	1.44	
(max depth 46 ft.)			Port	0.71	0.08	1.64	2.81	0.33	1.82	2.53	0.30	1.64	1.19	0.14	1.58
North Europe	49,973	4.70	Voyage	13.23	0.62		12.65	0.59		11.89	0.56		12.22	0.57	
(max depth 41 ft.)			Port	0.71	0.03	0.66	2.81	0.13	0.73	2.64	0.12	0.68	1.19	0.06	0.63
South Europe	44,126	4.15	Voyage	11.70	0.49		11.2	0.46		10.11	0.42		10.83	0.45	
(max depth 46/49 ft)			Port	0.71	0.03	0.52	2.81	0.12	0.58	2.53	0.10	0.52	1.19	0.05	0.50
South Europe	44,126	4.15	Voyage	11.70	0.49		11.2	0.46		10.54	0.44		10.83	0.45	
(max depth 41 ft.)			Port	0.71	0.03	0.52	2.81	0.12	0.58	2.64	0.11	0.55	1.19	0.05	0.50
Far East	550,760	51.00	Voyage	21.47	11.12		21.41	11.09		21.41	11.09		21.58	11.10	
(via Panama Canal) (max depth 39 ft.)			Port	0.71	0.37	11.49	2.81	1.46	12.55	2.81	1.46	12.55	1.24	0.64	11.82
	1,063,260	100.00	Voyage			17.71			17.39			16.91			17.29
			Port			0.71			2.81			2.70			1.22
			Subtotal			18.42			20.20			19.60			18.50
			Hinterland			11.16			9.66			9.66			12.12
			TOTALS			$29.58			$29.86			$29.26			$30.62

Note: Totals may not sum due to rounding.

47. The lower hinterland rates and 43-foot vessel loads at New Orleans in Table 28 <u>seem</u> to give the future competitive edge to New Orleans. But there is a specific cost at New Orleans which must be further analyzed--vessel delays (at anchorage). During the peak grain harvest season, shippers are sensitive to these delay costs which are shown in Table 29. Based on information furnished by Southern Steamship Agency in New Orleans (the agent for Russian grain ships), vessel delays at peak harvest were 9.5 days in 1979-1980 and 5.5 days in 1989. In Tables 27 and 28, an average annual delay of 3.5 days was used based on data from Southern Steamship Agency. As delay time increases at New Orleans, the Port of Pascagoula becomes more competitive. It is this delay time at New Orleans that explains the reason Pascagoula will maintain an average of 1,742,015 tons of grain in the without-project condition. This can be seen by the differences in costs per ton for a 3.5 day delay and a 9.5 day delay for 40 and 42-foot draft vessels in Table 29. In economic theory, these delays will cause vessels to continue to shift to other ports such as Pascagoula--economies of scale in larger sizes of vessel calling at New Orleans cannot overcome the additional delay costs at New Orleans.

TABLE 29
COSTS PER TON FOR VESSEL DELAYS AT NEW ORLEANS
(1 October 1991 Prices)

	Dry Bulk Carriers (dwt)			
	47,500 38'	60,000 40'	72,000 42'	75,000 43'
DAYS[a]	($)	($)	($)	($)
0.5	.15	.12	.11	.11
1.5	.45	.37	.34	.34
2.5	.75	.62	.57	.56
3.5	1.05	.87	.79	.78
4.5	1.35	1.12	1.02	1.01
5.5	1.65	1.37	1.25	1.23
6.5	1.94	1.62	1.47	1.45
7.5	2.24	1.87	1.70	1.68
8.5	2.54	2.12	1.93	1.90
9.5	2.84	2.37	2.16	2.12

[a]From Southern Steamship Agency, New Orleans

a. Existing Unit Costs. The dry bulk carrier fleet rting grain from Pascagoula to foreign destinations has been ribed in previous paragraphs; the reader is referred to Table gain. Based on port records, these vessels will fully load 8 feet under existing and future without-project conditions. fact necessitated inclusion of fully loaded classes of els starting at 38 feet in each fleet of vessels assigned to alternative channel depth. Table 28 displays a weighted per ton of $18.42 from Pascagoula under existing condition ine regions of the world based on the percentage of tonnage ined to each region.

b. Without-Project Condition Unit Costs. These unit costs identical to existing condition unit costs for grain exported Pascagoula.

c. With-Project Condition Unit Costs. A weighted cost per was computed for each nine regions to which grain is destined each successively deeper channel depth up to a 44 foot nel. Table 30 is a summary of weighted costs per ton based he world fleet distribution to each region for each proposed nel depth. Tables 31-33 further weights these costs by on for the 40, 42 and 44-foot alternatives so that a singular per ton can be associated with each alternative channel h.

TABLE 30
SUMMARY - WEIGHTED COSTS PER TON FOR GRAIN EXPORTS
FROM PASCAGOULA, MS BASED ON WORLD FLEET DISTRIBUTION
(1 October 1991 Prices)

FOREIGN DESTINATIONS	38 ft	PROPOSED CHANNEL DEPTHS 39 ft	40 ft	41 ft	42 ft	43 ft	44 ft
Black Sea Region (max depth 42 ft.) Cost/ton	16.86	16.31	15.86	15.49	15.24	15.24	15.24
East Mediterranean Region (max depth 43 ft.) Cost/ton	16.19	15.68	15.24	14.89	14.65	14.43	14.43
West Mediterranean Region (max depth 42 ft.) Cost/ton	13.32	12.90	12.54	12.25	12.06	12.06	12.06
E Coast S America Region (max depth 44 ft.) Cost/ton	14.35	13.95	13.50	13.19	12.98	12.75	12.65
E Coast S America Region (max depth 39 ft.) Cost/ton	14.35	13.95	13.95	13.95	13.95	13.95	13.95
North Europe Region (max depth 46 ft.) Cost/ton	13.96	13.49	13.12	12.81	12.62	12.42	12.30
North Europe Region (max depth 41 ft.) Cost/ton	13.96	13.49	13.12	12.81	12.81	12.81	12.81
South Europe Region (max depth 46/49 ft.) Cost/ton	12.41	12.01	11.68	11.41	11.23	11.06	10.96
Far East Region (max depth 39 ft.) Cost/ton	20.62	19.86	19.86	19.86	19.86	19.86	19.86

TABLE 31
WITH-PROJECT TONNAGES AND WEIGHTED COSTS/TON FOR GRAIN EXPORTS
FROM PASCAGOULA, MS BASED ON DISTRIBUTION TO REGION
(1 October 1991 Prices)

	40' CHANNEL			
FOREIGN DESTINATIONS	TONNAGE	%/REGION	COST/TON	WEIGHTED COST/TON
Black Sea Region (max depth 42 ft.)	88,251	8.30	$15.86	$1.32
East Mediterranean Region (max depth 43 ft.)	38,277	3.60	$15.24	$0.55
West Mediterranean Region (max depth 42 ft.)	35,088	3.30	$12.54	$0.41
E Coast S America Region (max depth 44 ft.)	34,024	3.20	$13.50	$0.43
E Coast S America Region (max depth 39 ft.)	53,163	5.00	$13.95	$0.70
North Europe Region (max depth 46 ft.)	125,465	11.80	$13.12	$1.55
North Europe Region (max depth 41 ft.)	49,973	4.70	$13.12	$0.62
South Europe Region (max depth 46/49 ft.)	88,251	8.30	$11.68	$0.97
Far East Region (via Panama Canal) (max depth 39 ft.)	550,768	51.80	$21.43	$11.10
TOTALS	1,063,260	100.00		$17.64

TABLE 32
WITH-PROJECT TONNAGES AND WEIGHTED COSTS/TON FOR GRAIN EXPORTS
FROM PASCAGOULA, MS BASED ON DISTRIBUTION TO REGION
(1 October 1991 Prices)

	42' CHANNEL			
FOREIGN DESTINATIONS	TONNAGE	%/REGION	COST/TON	WEIGHTED COST/TON
Black Sea Region (max depth 42 ft.)	88,251	8.30	$15.24	$1.26
East Mediterranean Region (max depth 43 ft.)	38,277	3.60	$14.65	$0.53
West Mediterranean Region (max depth 42 ft.)	35,088	3.30	$12.06	$0.40
E Coast S America Region (max depth 44 ft.)	34,024	3.20	$12.98	$0.42
E Coast S America Region (max depth 39 ft.)	53,163	5.00	$13.95	$0.70
North Europe Region (max depth 46 ft.)	125,465	11.80	$12.62	$1.49
North Europe Region (max depth 41 ft.)	49,973	4.70	$12.81	$0.60
South Europe Region (max depth 46/49 ft.)	88,251	8.30	$11.23	$0.93
Far East Region (via Panama Canal) (max depth 39 ft.)	550,768	51.80	$21.43	$11.10
TOTALS	1,063,260	100.00		$17.43

TABLE 33
WITH-PROJECT TONNAGES AND WEIGHTED COSTS/TON FOR GRAIN EXPORTS
FROM PASCAGOULA, MS BASED ON DISTRIBUTION TO REGION
(1 October 1991 Prices)

	44' CHANNEL			
FOREIGN DESTINATIONS	TONNAGE	%/REGION	COST/TON	WEIGHTED COST/TON
Black Sea Region (max depth 42 ft.)	88,251	8.30	$15.24	$1.26
East Mediterranean Region (max depth 43 ft.)	38,277	3.60	$14.43	$0.52
West Mediterranean Region (max depth 42 ft.)	35,088	3.30	$12.06	$0.40
E Coast S America Region (max depth 44 ft.)	34,024	3.20	$12.65	$0.40
E Coast S America Region (max depth 39 ft.)	53,163	5.00	$13.95	$0.70
North Europe Region (max depth 46 ft.)	125,465	11.80	$12.30	$1.45
North Europe Region (max depth 41 ft.)	49,973	4.70	$12.81	$0.60
South Europe Region (max depth 46/49 ft.)	88,251	8.30	$10.96	$0.91
Far East Region (via Panama Canal) (max depth 39 ft.)	550,768	51.80	$21.43	$11.10
TOTALS	1,063,260	100.00		$17.35

48. Crude Oil (import): No other alternative modes of transportation could be considered for importing crude oil to the Bayou Casotte refinery--shipment in ultra/very large tankers (ULCC/VLCCs) from Saudi Arabia or Mexico to 25 miles off shore and then transloading to a 78,656 dwt tanker for "lightering" to the refinery. Lightering the crude to Empire, Louisiana at 40 foot drafts and later piping the crude to the refinery costs an additional $1.60 per short ton ($.25 per barrel) based on the Feasibility Report. This is the only other alternative "transportation" method available; however, this is not a viable alternative to the lightering operation for two reasons: a) the additional $1.60 per ton for delivery and b) capacity production of the refinery could not physically be maintained with a sole pipeline. The pipeline is used only for emergencies **when bad weather prevents the lighters from delivering the crude. In rare cases, domestic crude prices could be lower than foreign prices and Gulf of Mexico crude could be delivered via this pipeline; however, this refinery does not plan to use domestic crude, except in emergencies.**

A brief description of Chevron's refinery and lightering operations is presented here. Depending on demand for Chevron's finished products (product mix), up to 4 ULCC/VLCCs can be sitting 25 miles offshore waiting to be emptied by these lighters. Each mother ship can be loaded with a different grade of crude. This processing plant is Chevron's largest heavy crude cracking plant in the continental U.S. ($1.3 billion expansion in 1984). It can run sweet or heavy crude, depending on demand for finished petroleum products. Onshore storage tanks capacity is 3.5 million barrels; this storage is maintained at least 50% full (1.75 MB) at all times, which is a 5 to 6 day supply of crude (the refinery uses 300,00 barrels per day). Inclement weather can prevent the lighters from delivering the crude for periods up to 5 to 6 days.

An onshore storage analysis was completed by Chevron in 1991 to determine the most efficient storage options for the operation of the refinery. The analysis concluded that it was cheaper to operate with the mother ships as "floating storage" and reduce these "floating storage" costs from outcharter profits of one of the two new lighters. Construction of additional onshore storage was found to be very expensive since environmental mitigation would have been extensive.

Employing additional inefficient lighters was also considered (as an alternative to building more onshore storage) but proved to be the most expensive alternative. Chevron built two efficient lighters and dedicated them to the Pascagoula refinery, even though much of the time of the second lighter is not needed at Pascagoula. This existing lightering operation is the most efficient mode of delivery of crude for this refinery located on this particular channel.

All of the Chevron savings associated with their lightering operations are brought about by more efficient utilization of the lightering vessels due to the time savings on each trip from widening the bar, providing a new turning basin or deepening the channel. Under with project conditions, Chevron estimates that one vessel can service the needs of the refinery for extended periods of time by optimizing the use of onshore storage. This one-vessel operation is not possible under the without project condition. The following paragraphs describe the differences in operations of the lighters for existing, without project and with project conditions and converts their costs to a unit (per ton) cost.

a. Existing Unit Costs. The hours for a lighter vessel to make a round trip are described in Table 34. Each leg or functional segment of the trip has been described in this table. The existing unit cost to lighter the crude from the mother ship to the refinery is $0.789 per ton (excluding the costs to the VLCC/ULCCs to wait for the lighters to empty them **and excluding costs for non-channel related delays**).

b. Without-Project Unit Costs. These unit costs will remain the same as for the existing condition.

c. With-Project Unit Costs. The two new and modern 78,656 dwt tankers used in the lightering operations for Chevron are more fully described in Table 35 (carrying capacity at each draft in thousands of barrels of crude, underkeel clearances required, etc.). These tankers were designed for the narrow channel width into and within the inner harbor. Their features include: a) variable pitch speed control for very slow speeds while loaded and traveling the upper channel, passing Chevron's finished products docks (Docks 1-5) in the inner harbor and turning within a minimal radius in the existing turning basin to avoid moored ships in the turning basin; b) sophisticated radar (doppler) equipment for continuously providing the pilots and ship captain with channel bottom cross-sections and configurations for safer control of the tankers; and c) other specialized rudder controls for maneuverability.

Table 35 summarizes the hours required for a lighter roundtrip at each alternative considered. The operations of the mother ships (ULCCs/VLCCs) have been excluded in this analysis. No trips to Saudi Arabia or Mexico can be saved by the mother ships (e.g. 17,246,250 tons of crude must be delivered annually). And no waiting time by the mother ships can be reduced with the elimination of delays by the lighters awaiting daylight in order to cross the bar. Reductions of one hour travel time by the lighters to and from the existing turning basin would not reduce the waiting time by the ULCC/VLCCs either. **Construction of additional onshore storage tanks would be required in order to claim benefits for faster turnaround of the ULCC/VLCCs. Based on**

TABLE 34
EXISTING TRANSPORTATION COSTS PER TON - LIGHTERING OPERATIONS
(CRUDE OIL).

Lighter Trips Annually (docks to VLCC/ULCC and return): 230.5

Total Short Tons Delivered: 17,246,250

Hours Per Roundtrip: 42.42[a] (32.5 hours actually lightering + 4.42 hours delay waiting for daylight, a 5.0 and 0.5 hour weather delay at the ULCC/VLCC and at the bar, respectively)

Hourly Cost: $1,098 (outcharter rate)

Total Annual Costs: $13,612,030 (excludes all delays to VLCC/ULCC to wait)

Costs Per Ton **to lighter from VLCC/ULCC to refinery** = $0.789

[a]Trip Time (including loading/unloading):

	Hours
Dock to Sea Buoy (empty)	1.5
Sea Buoy to Mother Ship	2.25
Ship to all Fast	1.5
All Fast to Begin Transfer	0.5
Loading (67,850 Barrels/hour = avg.)	7.0
Complete Transfer to Last Line	1.0
Last Line to Sea Buoy (loaded)	2.25
Average Delay Awaiting Daylight **because of the bar**	4.42
Travel the channel	2.0
Travel to Turning Basin, Turn and travel back to dock	1.5
All Fast to Begin Transfer	1.5
Discharging	10.0
Bunker (included in discharge time)	---
Unhook at Dock	1.5
Weather delay at ULCC/VLCC	5.0
Weather delay **because of** bar	0.5
Total Hours	42.42

TABLE 35

LIGHTERING ASSUMPTIONS AND BENEFITS AT ALTERNATIVE CHANNEL DEPTHS (1 Oct 91 Prices)

Assume: 2' Underkeel clearance for LV; Maximum draft of LV is 40'; 17,246,250 short tons/year	WITHOUT-PROJECT (38')	WITH-PROJECT 38' Widen Bar	38' New T.B.	38' Bar + T.B.	40'	40' Bar + T.B.	42'	42' Bar + T.B.
Daily Barrels Crude to Refinery	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000
Barrels/LV Voyage	475,000	475,000	475,000	475,000	510,000	510,000	535,000	535,000
Lightering Voyage Hours:	Lightering Voyage Hours							
Dock to sea buoy - ballast	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Sea buoy to VLCC/ULCC	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.25
Ship to all fast	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
All fast to begin transfer	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Loading	7.00	7.00	7.00	7.00	7.52	7.52	7.88	7.88
Complete transfer to last line	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Last line to sea buoy (loaded)	2.25	2.25	2.25	2.25	2.31	2.31	2.37	2.37
Delay awaiting daylight	4.42	0.47	4.08	0.00	4.42	0.00	4.42	0.00
Travel the channel (cross bar) *	2.00	2.00	2.00	2.00	2.04	2.04	2.08	2.08
Travel to T. B. and turn *	1.50	1.50	0.50	0.50	1.50	0.50	1.50	0.50
All fast to dock	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Discharge	10.00	10.00	10.00	10.00	10.74	10.74	11.26	11.26
Unhook at dock	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Weather delay @ ULCC/VLCC	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Weather delay @ Bar	0.50	0.00	0.50	0.00	0.50	0.00	0.50	0.00
Total hours/LV Voyage	42.42	37.97	41.08	36.50	43.78	37.86	44.76	38.84
LV Voyages/Year Needed	230.50	230.50	230.50	230.50	214.70	214.70	204.70	204.70
LV Days/Year Needed	407.4	364.7	394.5	350.6	391.6	338.7	381.8	331.3
LV Days/Year Saved		42.7	12.9	56.8	15.8	68.7	25.5	76.0
Outcharter Utilizaton Rate		75%	25%	75%	50%	75%	50%	75%
Days Saved for Outcharter		32.1	3.2	42.6	7.9	51.5	12.8	57.0
	Benefits (CY91$)							
Benefits for Outcharters @ $1098/hr	(10,736,035)	844,685	84,785	1,121,739	207,656	1,358,172	336,558	1,502,774
Reduced Tug Costs	(553,200)	0	276,600	276,600	37,920	295,560	61,920	307,560
Reduced Port Charges	(1,383,000)	0	0	0	94,800	94,800	154,800	154,800
Reduced Fuel/Lube Charges	(939,795)	15,628	5,209	20,837	25,602	45,011	40,425	58,930
Total Savings	(13,612,030)	860,312	366,594	1,419,176	365,978	1,793,543	593,703	2,024,063
Savings Per Ton	(0.789)	0.050	0.021	0.082	0.021	0.104	0.034	0.117

Note: For delays awaiting daylight, assume: daylight is 6 am-6pm, random arrivals & functions above with * can occur in daylight only.

A) Without-Project: Maximum delay is 14 hours for LVs arriving at seabouy from 4 pm - 6 am. Arrivals between 2:30 pm & 3 pm incurs a 0.5 hr delay waiting daylight to turn. Average delays are 7 and 9.25 hours; probabilities of delays are (4/24 (.5833) and 0.5/25 (.021), respectively. All functions shown above can occur at night except those with an asterisk.

B): With-Project (widen bar): LVs arriving at SB between 2:30 pm and 3 pm would still have the wait for daylight to turn. Also, those arrivals between 1:30 am and 4 am would have to wait up to 2.5 hours for daylight to cross the bar.

C): With-Project (Widen Bar and a new T.B.): All delays awaiting daylight are eliminated when a new T.B. is added to widening the bar.

these studies by Chevron in 1991, it was cheaper to use the VLCC/ULCCs as "floating storage", since environmental mitigation costs were prohibitive. (Employing additional, less efficient lighter vessels was also compared to the cost of additional onshore tankage, and was found to be the least efficient alternative by Chevron.)

49. The harbor pilots at Pascagoula Harbor have three rules regarding vessels transiting their channels: a) those with drafts at or greater than 34 feet must wait for daylight to cross the bar; b) those with lengths at or greater than 685 feet must be turned in daylight only; and c) those with minimum speeds greater then 2 knots are not allowed to pass Chevron's finished products Docks 1-5 while loaded--all transiting vessels must pass by these docks empty (lash and RoRo vessels can pass Docks 1-5 in daylight only because of their speed, length and freeboard). The lightering tankers transporting the inbound crude are generally loaded to a 36 foot draft, they are 785 feet in length, but they can reduce speeds to 2 knots with their variable pitch speed controls. Therefore, two of the pilots' criteria apply to these Chevron lighters. The variable pitch speed control allows these tankers to be able to slow to 2 knots inbound while passing finished products Docks 1-5 in the inner harbor; however, their length prevents their turning except in daylight. Their inbound loaded drafts of 36' also prevent them from crossing the outer bar except in daylight. After discharging, the empty tanker can cross the bar at night. The following analysis of the amount of delay to assign to their waiting because of the bar and because of the turning basin restrictions are based solely on the inbound loaded leg of their round trip. Random arrivals at the seabouy were assumed in this analysis; the outer seabuoy is the starting point of channel-related problems, or maximum delay.

The reason for the wait at the bar is explained first. A vessel entering this channel must first maneuver through a continually shoaling portion of the gulf. Under present conditions, the channel then makes a sharp dog-leg (a turn to the west and then a sharp turn back to the east) at the end of Petit Bois Island. This dog-leg is caused by the migration of Petit Bois Island to the west. Shoaling is continually occurring throughout the dog-leg portion also. Hazards associated with these quick maneuvers by the harbor pilots are magnified by currents, winds and lack of visibility at night. Since a considerable number of these vessels carry volatile cargoes (crude, jet fuel, etc.) the pilots' harbor rules limit the transit to daylight hours to avoid the risk of closing the entire channel due to a vessel grounding or a chemical/oil spill. The Pascagoula Harbor pilots' operating restrictions for crossing the bar, turning and restricted speeds while passing docks 1-5 in Bayou Casotte are contained in documents in MDO files.

The Chevron refinery and its lightering operation is the predominant user of the channel. There are numerous other types of vessels using this channel--Navy vessels from Ingalls Shipbuilding, grain exports, petroleum coke exports, numerous breakbulk ships, and numerous exported petroleum product tankers and barges. Chevron imports 17+ million tons of crude and then ships much of these finished products via this channel in ships. Chevron's operations are critical to the economy of the area; these large lightering ships are treated accordingly.

Widening and relocating Horn Island Pass would straighten the channel through the Pass. All vessels fully utilize the existing 38' channel; however, they do so in daylight only--<u>they wait if it is night</u>. The 34' draft restriction <u>at night</u> would be eliminated with widening the Pass; however, no benefits are assigned in this analysis to eliminating this 34' draft restriction. Only elimination of the <u>waiting</u> at the bar is assigned as benefits to widening the Pass. Any benefits associated with allowing vessels to load to greater drafts are assigned to the deeper channel alternatives.

Waiting outside the channel for daylight, if only the bar channel is widened, would still be required if: a) the vessel is too long to turn; or b) the vessel's speed cannot be reduced to 2 knots while passing the chemical/petroleum products docks inside the Bayou Casotte channel while loaded; or c) both conditions. These restrictions apply singularly and collectively. The new turning basin would eliminate these other delays, as shown in the following paragraphs. The details of the maneuvers of the vessels and the calculations of the related delays waiting for daylight are included.

Table 35A shows the segments of the delay assigned to these lighters. The delay of the inbound (loaded) lighters of 4.42 hours at the bar awaiting daylight is based on the fact that there are 12 hours each of daylight and darkness in each day on an annual basis. Unless the loaded inbound tanker has 3.5 hours of daylight remaining upon arrival at the bar to travel the channel (2.0 hours), travel to the turning basin, turn and return to dock 6 or 7 (1.5 hours), the lighter waits at the bar for daylight. This lighter can pass by Docks 1-5 with another moored tanker loading volatile chemicals (jet fuel, etc.) at 2 knots with almost full control of the vessel; however, two tugs are attached to insure safety. Maximum wait because of the bar, then, is 14 hours since arrivals at 4:01 p.m. at the outer seabuoy must wait until the next morning to cross the bar. Almost all of the lighters are turned and docked with their bow facing the south (ready to leave) because of the possibilities of a hazard in the inner harbor which would trap these large tankers were they not turned.

TABLE 35A

Delays to Crude Lighters and Grain Vessels Operating at Pascagoula Harbor
Without-Project Condition

PERIOD OF DELAY: Arrivals @ Seabouy	Operations	Maximum Delay	Avg. Delay	Probability of Delay	Hours Delayed
		-----------At Bar/Pass and Turning Basin Combined----------			
		----------Crude (Loaded Inbound)---------			
4:00 pm - 6:00 am	Turned (bow south)	14	7	0.5833	4.08
2:30 pm - 3:00 pm	Not turned (bow north)	0.5	0.25	0.021	0.01
6:00 am - 4:00 pm	Additional Wait for pilot/tug callout for NuSouth vessels	2.5	1.25	0.267	0.33
					4.42
Waiting @ Docks		----------Grain (loaded outbound)---------			
4:00 pm - 6:00 am	Turned (Bow South)	14	7	0.58	4.08
		---------Residual Delays with Bar Widening Only------------			
Arrivals @ Seabouy		----------Crude (Loaded Inbound)---------			
4:00 pm - 6:00 am	Turned (bow south)	0	0	0.5833	0.00
2:30 pm - 3:00 pm	Not turned (bow north)	0.5	0.25	0.021	0.01
1:30 am - 4:00 am	Turned (bow south)	2.5	1.25	0.104	0.13
6:00 am - 4:00 pm	Additional Wait for pilot/tug callout for NuSouth vessels	2.5	1.25	0.267	0.33
					0.47
Waiting @ Docks		----------Grain (loaded outbound)---------			
4:00 pm - 6:00 am	Turned (Bow South)	0	0	0.58	0.00

Note: The new crude tankers have variable pitch speed control and can attain speedse as low as 2 knots; therefore, there is little or no damage from pulling moored tankers away from from the F. P. docks (damages to lines, tankers, and piers with the risk of an explosion). The probability of delay caused by NuSouth shifts was based on the pier utilization rate for NuSouth vessels (8 vessels per month, or .2667)
All the residual delays waiting for daylight will be eliminated when a new is added to the widened bar.

ıose arrivals at the seabuoy between 2:30 p.m. and 3:00 p.m. ıst dock with their bow to the north (not turned) since enough aylight does not exist to finish the two functions required to ccomplish a turn and be ready to tie up at Dock 6 or Dock 7 by :00 p.m. This involves a very small portion of the fleet of ighters and equates to 0.01 hours of delay as shown in Table 5A. Additionally, those arriving between 6:00 a.m. and 4:00 .m. may encounter the necessity to shift a NuSouth vessel which s loading in the turning basin. Call out of tugs and pilots for NuSouth vessel shift could be up to 2.5 hours (1.5 hours for ne NuSouth shift and 0.5 hours for call out of the tug or the ilot on each end of the shift); however, the lighter is ubjected to this possibility only at the probability of a uSouth vessel being in the turning basin at their most southern oading dock (8/30 or .2667), which causes another 0.33 hours of elay to the lighter per trip. (NuSouth vessels using their orthern most pier do not have to shift when the lighter is using he existing turning basin.)

ased on data furnished by Chevron and the harbor pilots, a 0.5 our average weather delay was assigned to the loaded leg of the ighter trips **because of the narrow bar** (and the loaded leg of ll other types of vessels using the harbor). This weather delay s in addition to the delay waiting for daylight. High winds and igh waves lessen the vessels' maneuverability and their bottom learance, which in both cases affect the safety of the ship.

f the lighter has already been turned, the empty tanker can eave at night and cross the bar without any delays on its return o the ULCC/VLCC. **There are no benefits in this analysis to the utbound leg of the lighters.**

0. Two situations cause delays to remain with widening the bar olely (and not providing a new turning basin). These are escribed in the second half of Table 35A. Those arrivals at the eabuoy between 2:30 p.m. and 3:00 p.m. which get to Dock 6 or 7 efore night (not turned) discharge their crude during the night nd still wait up to 0.5 hours for daylight in order to turn. dditionally, arrivals at the seabuoy between 1:30 a.m. and 4:00 .m. can transit over the bar since it has been widened, but must ait up to 2.5 hours for daylight to <u>turn</u>. The NuSouth shifts emain a delay factor for the lighters with a widened bar and no ew turning basin. A total of 0.47 hours of delay remain for the ighters with the widening alternative if it were constructed ingularly; conversely, 3.95 hours of delay are reduced for the ighters with widening the bar only.

1. The 0.47 residual hours of delay waiting for daylight shown n the second half of Table 35A would not be entirely eliminated f a new turning basin only were constructed at Bayou Casotte. he 0.5 hour delay of the lighters associated with arrivals at he seabuoy between 2:30 p.m. and 3:00 p.m. would remain in this

case, or 0.01 hours of delay. The one hour incremental difference in travel time to and from the old turning basin to a new turning basin across from Docks 6 and 7 would be eliminated with construction of a new turning basin solely.

There are extensive safety benefits associated with a new turning basin across from Docks 6 and 7. Only these new, modern lighters have the variable pitch control speed and can safely slow to 2 knots while passing Docks 1-5. The coke vessels, lash ships (960' long), RoRo's (860' long) which have minimal speeds of 6-7 knots literally suck any moored chemical tanker loading at Docks 3 or 5 away from their slips, break lines, damage piers, and damage the tankers themselves. There is a considerable safety hazard existing in this inner harbor as large (empty or loaded) vessels pass these chemical discharging docks. In addition to this hazard, another hazard exists in the turning basin as turning vessels must contend with moored, large vessels loading volatile cargoes in the most southern pier on the east side of the existing turning basin. To illustrate, a skilled pilot turning a 785'-long tanker in the existing 960'-wide turning basin must place the prop of the tanker almost against the west wide of the turning basin, allow 100 feet of the stern section to extend outside the turning basin and contend with no forward visibility as the bow of the vessel completely blocks the view from the wheelhouse during the turning process. The NuSouth vessels moored in the east side of the turning basin reduce the turning basin width by 65 feet; thus, the reason for forcing NuSouth to shift their tankers to piers G or H. The new turning basin must be constructed to full channel depth for safety of the lighters and moored tankers at Docks 3 or 5. Their ability to quickly exit from the refinery area in case of fire or explosion would enhance the safety of the entire inner harbor at Bayou Casotte. An explosion at Dock 3 in July, 1986 destroyed one barge and severely damaged the entire discharge facilities (Docks 1, 2, 3, 4 and 5). This explosion could have destroyed any lightering tanker docked at Dock 6 or 7. A new turning basin would allow all lighters, coke vessels and tankers at Dock 3 or 5 to be turned before discharging or loading. Should an explosion or fire occur at or near Dock 6 or 7, coke dock or Docks 1-5, the loaded, partially loaded, or empty tanker could immediately exit the area. Also, the new turning basin would allow day and night turns which would afford more efficiency to all of the lighters, coke and finished product tankers using this harbor. Travel time to or from the new turning basin to Docks 6 and 7 compared to the existing turning basin would be a reduction of one hour for the lighters.

The data in Table 35 presents the differences in vessel operating times with each improvement (widen bar, provide a new turning basin, deepen and combine the first two components). This table also shows differences in outcharter rates, fuel costs, tug costs port charges for these lighter vessels. Each of these egories **of costs shall be discussed in this order.**

a. **Outcharter Rates.** Hourly vessel operating costs provided the U.S. Army Corps of Engineers are normally used to ermined benefits to more efficiently use vessels exporting or orting commodities within a harbor; e.g., more cargo can be nsported in deeper draft vessels, thus fewer trips are needed. vrón's crude lightering operations require a slightly ferent approach. These two lighters were constructed cifically for this channel and this refinery's operation at cagoula. These tankers are "dedicated" to this refinery. se vessels can, however, be used for lightering operations at er Gulf of Mexico refineries such as Texas, Louisiana or eport, Bahamas, if enough time can be freed from their ication to the Pascagoula refinery. Chevron can outcharter m to other companies, and any vessel operating benefits imed in this analysis are expressed as earnings to Chevron m outchartering the vessels to other users. The without-ject condition hourly operating costs ($1,098) used in this lysis comply with Corps guidelines for computing hourly costs any other foreign flag tanker; this hourly cost includes ts for special loading equipment and future costs for double ls starting in the Year 2000. No distinction between the ts "at sea" and "in port" are necessary since Chevron bills other user for the outcharter on a daily basis. The need to ress their "at sea" or "in port" differences has been minated. Fuel, lubricating oils and port charges have been luded from these outchartering hourly rates since these egories of costs are considered savings to the Pascagoula rations. The outchartering earnings and fuel, oils and port rges at their Pascagoula operations have been included as efits if efficiencies are created by the proposed alternatives wn in Table 35.

vron's methodology for determining the outcharter utilization es is discussed here. These rates were prepared by Chevron's ker Operations Division in San Francisco working closely with Chevron Refinery Operations Division at Pascagoula. These charter rates were calculated based on: a) the distances to h of their customers who regularly use these lighters to iver crude from these same mother ships (or from other rations in the Gulf); b) the myriad problems with projecting and for different product mixes at the Pascagoula refinery; c) efficiency of the two new lighters; d) onshore storage acity at Pascagoula; and e) the channel problems at cagoula. These outcharter rates for each of these project rements were deliberated carefully so that <u>no production ays</u> would be incurred at the Pascagoula refinery. Their ionale for each rate and all related documents are in MDO es as backup.

Currently, both lighters are not in use 100% of the time in the Pascagoula operation. Actually, it takes less than 1.5 lighters to keep the refinery at full production. The unused portion of the second lighter is currently outchartering to other refineries.

The days saved from faster turnaround of the lighters increases the time available for outcharter as shown in Table 35 on page C-50 on an <u>annual basis</u> (42.6 days for the combined bar widening and new turning basin). Chevron's rationale is as follows:

1) The two lighters working together with faster turnarounds can fill all onshore storage at a faster rate under the with project condition thus allowing the second lighter to be used to make outcharter trips to refineries which have deep draft terminals and which are within the radius of the outcharter formula. Regular customers for these lighters include 7 refineries located at Houston, Galveston, Corpus Cristi, New Orleans, Baton Rouge, LOOP (at New Orleans), Mobile, Freeport (Bahamas) and Jacksonville, Florida.

2) Once the onshore storage tanks are full, one lighter can service the refinery for extended periods of time before the second lighter is again required to fill the tanks. These saved hours (and saved trips in the case of deepening) amount to <u>at least</u> an additional 1/4 of the second lighter being free to make money for Chevron rather than sitting idle.

The following is a <u>simplistic</u> scenario of how the two lighters working together can fill the onshore tanks which would allow the second lighter to outcharter (assuming <u>ideal</u> conditions such as no inclement weather, no breakdowns, no other ship needs to use the channel, or no other problems of any kind) . Assume that the onshore tanks are 1/2 full. Under without project condition, each lighter would carry 475,000 barrels per trip which takes 42.42 hours (or 1.77 days); the plant uses 300,000 barrels per day. It would take the two lighters 17.7 "lighter" days to fill the tanks working together for 10 calendar days, since there would be a 175,000 net increase in tankage every calendar day (1.77 "lighter" days x 10 calendar days). Once this 10 calendar-day process is complete and the tanks are full, one lighter is freed up to outcharter. With only one lighter delivering crude during the drawdown period (using the onshore storage tanks to supplement the amount delivered by the lighter), the drawdown to 1/2 full would take approximately 52 days (again, ideally speaking). The full cycle of the tanks are, then, 17.70 days plus 52 days for a total of 69.7 days for without project condition.

Under with project condition, the two lighters can fill the onshore tanks in 15.2 "lighter" days each filling/draw down process (36.50 hours per trip/24 hours per day = 1.52 days/trip), which represents a savings on the fill up of 2.5 days. Once the tank is full (under the ideal conditions described above), the refinery could operate for almost an indefinite period of time with one lighter.

Numerous unknowns can cause this onshore tankage cycle to be longer under the without project condition or shorter under the with project condition--inclement weather is probably the main culprit (high waves can and does delay loading at the ULCC/VLCCs; hookup nor the discharging process can occur). Bad weather can also cause the lighter to sit outside the bar, or sit at the docks. Also, the need for various crude mixes at a given point in time could require the use of the two lighters, even during the drawdown period (if the required combination of crude mixes are not in the storage tanks). Considering all the difficulties associated with projecting all these variables, the analysis shown in the report was based on average times as shown in Table 34.

The relatively small per voyage time savings would translate into usable time because the time savings will generally accumulate from several back-to-back lightering voyages. This time is then combined with the free time which already exists for the second lighter which is already outchartering. A portion of the freed time will not be used because some freed time comes in small increments, or does not "piggy-back" on other free time. For example, in the cases of positioning the lighter to Texas for an outcharter, it takes a total of 2 days to position to/from Pascagoula and about 3 days to make the lighter voyage. If only one voyage is completed before returning to Pascagoula, the utilization rate is 60% (3 revenue earning days/5 total days needed). For two consecutive outcharters, the utilization rate increases to 75% (6 revenue earning days/8 total days needed), and for three consecutive outcharters, the utilization rate is 82% (9/11). Clearly, as more time becomes available, it is easier to utilize the time efficiently. For a single outcharter from Mexico to Texas, with a normal Mexico/Texas round trip time of about 7 days, the Pascagoula/Mexico/Texas/Pascagoula voyage would take about 8.5 days for a utilization rate of about 82%. Based on this information, Chevron concluded that they could successfully use 75% of the largest increments of time saved from widening the bar, or any combination thereof. For the increments of time saved which were less, Chevron could not guarantee that this saved time could piggy-back efficiently onto the already free time of the lighter. Thus, Chevron used a 50% utilization rate or less.

As far as the availability of ULCC/VLCC being a constraint on the lighter's ability to make an outcharter, there is no connection between the two conditions. <u>Up to</u> 4 mother ships are offshore <u>all the time</u>; they are not a constraint on the lighter's

ability to make an outcharter. The only premise upon which the lighter can make an outcharter is that the onshore storage tanks are between 1/2 full and full; and the other lighter can keep the refinery running at full capacity while this outcharter is taking place. At no time would the refinery's output be at jeopardy during an outcharter. The following paragraphs summarize the differences in outcharter rates for each increment of channel improvement.

Not all of the time freed by each proposed increment of improvement (widen bar, provide a new turning basin, or deepen) was extensive enough to **piggy-back onto already free time of the second lighter to** actually outcharter the lighters to another company. See Table 35 again. These percents of potential outcharter range from 25 percent of the freed time created by constructing a new turning basin solely to 75 percent for widening the bar or several combinations of alternatives. These percents of outcharter were determined by Chevron shipping and refinery personnel.

b. **Fuel and Lubrication Savings:** Without-project bunkers and lubes were 34.9 and 0.1 metric tons respectively per trip. Depending on the increased load for deepening alternatives, these use rates increased. They decreased if no delays were encountered at the bar awaiting daylight or if travel time to the old turning basin were eliminated.

c. **Reduced Port and Tug Charges:** For without-project condition, $6,000 per voyage is paid by Chevron for port charges. A deeper channel reduces these trips. Reduced tug costs of $1,200 per trip occur with reduced trips and a new turning basin.

52. For computing benefits to the lighters in Table 35, the calculations of days for outcharter for computing benefits were important to understanding the benefits to these lighters. Therefore, residual operating costs with each alternative were not displayed in Table 35. These benefits were converted to a unit savings and displayed.

53. Petroleum Coke (export). Since this product is produced as a by-product of the crude and is stockpiled dockside, it is all sold F.O.B. dockside to foreign customers. Alternative transportation modes were not a consideration.

a. Existing Unit Costs. The weighted cost per ton (weighted by the proportion of each class of vessels to the total deadweight tonnage in the world fleet) to the average distance to all of European (northern and southern) and the Mediterranean destinations is $15.76 per short ton. This weighting process is shown under the 38-foot alternative on Table 23. Port records were examined for loaded sailing drafts of these coke vessels, and numerous vessels were topping off at another U.S. port before going to Europe. SSM Carbon was queried and feels that this same practice may exist under with-project condition since Chevron's perception of these vessels' interferences with their crude lightering logistics will continue regardless of the channel depth availability. Specifically, these vessels were light-loaded several feet upon leaving Pascagoula.

b. Without-Project Unit Costs. These costs are assumed to be the same as for the existing condition.

c. With-Project Unit Costs. The with-project condition weighted unit costs for export petroleum coke to an average distance from Pascagoula to Northern and Southern Europe and the Western Mediterranean ports are also shown on Table 23 for each considered alternative channel depth.

54. Summary. Table 36 displays the without- and with-project condition unit costs for each of the commodities analyzed.

TABLE 36
COSTS AND SAVINGS PER TON - PASCAGOULA HARBOR
(1 October 1991 Prices)

	COSTS PER TON ($)				
	WITHOUT-PROJECT	WITH-PROJECT			
	38'	39'	40'	42'	44'
BAYOU CASOTTE CHANNEL:					
Crude Oil (import)	0.789	----	0.768	0.754	0.754
Petroleum Coke (export)	15.76	----	13.93	12.89	12.35
PASCAGOULA RIVER:					
Bulk Grain (export)	18.42	17.81	17.64	17.43	17.35
		SAVINGS PER TON ($)			
BAYOU CASOTTE CHANNEL:					
Crude Oil (import)	----	----	0.021	0.035	0.035
Petroleum Coke (export)	----	----	1.83	2.87	3.41
PASCAGOULA RIVER:					
Bulk Grain (export)	----	0.61	0.78	0.99	1.07

Note: It was necessary to evaluate grain at 39' for two reasons:
a: Crude pipeline relocations on Pascagoula River leg are necessary at 40'; and
b: Over half the grain exports are limited to the Panama Canal depth of 39'.
Crude costs per ton were taken from Table 35.

SUMMARY - ECONOMIC BENEFITS FOR NAVIGATION

55. Methodology. The transportation benefits resulting from a deeper channel at Pascagoula Harbor would be generated by more efficient utilization (greater loadings) of vessels presently calling at the port, reduced vessel transit times and port times, and other benefit categories which include reduced port handling charges, reduced pilotage fees, etc.

56. Benefits to a Deeper Channel. With a deeper channel at Pascagoula, transportation benefits accrue to shippers who will fully utilize the channel(s) to import and export commodities through the Port of Pascagoula under the with-project condition(s). Table 37 shows the benefits for selected years over the project life (1996-2046). These benefits were generated by multiplying the tonnages in Table 15 by their respective unit savings in Table 36. It should be noted that these benefits for the base year (first year) of the 40-foot, 42-foot and 44-foot projects exceed $3.2 million, $4.8 million and $5.5 million, respectively. These base year benefits, in fact, would be the benefits for a "no growth" scenario for all commodities.

57. Benefits to a Wider Channel. Most of the transportation benefits are generated by more fully loading the existing vessels calling at the port, which is a depth-related benefit. There are no benefits related to widening the straight part of the channels based on port records and pilot data on vessel speeds.

58. Benefits to a Wider Upper Bayou Casotte Channel. The largest Chevron lightering vessels, coke vessels, finished product tankers, RoRo and lash vessels which use the Upper Bayou Casotte Harbor channel must reduce speeds over this 220-foot-wide, 3.6 mile-long channel in order to safely transit this leg. However, based on data from the harbor pilots, minimal increases in speed (less than 0.25 knots) will occur with outbound vessels with a wider channel because of the turn at the "Y". No increases in speed will occur with inbound vessels with a wider channel since the distance (3.6 miles) is almost minimal for a complete stop at Chevron's most southern dock (Dock 7) or come to a dead slow in order to pass this dock. Therefore, no transportation savings can be generated for this alternative.

59. Benefits to a Wider Bar and Pass Channel. There are two types of delays because of the narrow bar, especially when combined with the existing turning basin: a) delays waiting for daylight and b) fleet interaction delays incurred during the night from vessels waiting on each other. Those delays in category 1 shall be discussed first.

TABLE 37
TRANSPORTATION SAVINGS FOR ALTERNATIVE CHANNEL DEPTHS
PASCAGOULA HARBOR
(1 October 1991 Prices)

CHANNEL:	UNIT SAVINGS ($)	SAVINGS FOR A 40' CHANNEL (1,000) 1996	2006	2016	2026	2036	2046
Bayou Casotte:							
Crude Oil (import)	0.021	362.2	362.2	362.2	362.2	362.2	362.2
Petroleum Coke (export)	1.83	2,003.9	2,003.9	2,003.9	2,003.9	2,003.9	2,003.9
SUBTOTAL		2,366.0	2,366.0	2,366.0	2,366.0	2,366.0	2,366.0
Pascagoula:							
Bulk Grain (export)	0.78	829.4	867.4	907.3	927.9	927.9	927.9
TOTAL		3,195.4	3,233.5	3,273.3	3,293.9	3,293.9	3,293.9

CHANNEL:	UNIT SAVINGS ($)	SAVINGS FOR A 42' CHANNEL (1,000) 1996	2006	2016	2026	2036	2046
Bayou Casotte:							
Crude Oil (import)	0.035	603.6	603.6	603.6	603.6	603.6	603.6
Petroleum Coke (export)	2.87	3,142.7	3,142.7	3,142.7	3,142.7	3,142.7	3,142.7
SUBTOTAL		3,746.3	3,746.3	3,746.3	3,746.3	3,746.3	3,746.3
Pascagoula:							
Bulk Grain (export)	0.99	1,052.7	1,101.0	1,151.6	1,177.7	1,177.7	1,177.7
TOTAL		4,798.9	4,847.2	4,897.8	4,924.0	4,924.0	4,924.0

CHANNEL:	UNIT SAVINGS ($)	SAVINGS FOR A 44' CHANNEL (1,000) 1996	2006	2016	2026	2036	2046
Bayou Casotte:							
Crude Oil (import)	0.035	603.6	603.6	603.6	603.6	603.6	603.6
Petroleum Coke (export)	3.41	3,734.0	3,734.0	3,734.0	3,734.0	3,734.0	3,734.0
SUBTOTAL		4,337.6	4,337.6	4,337.6	4,337.6	4,337.6	4,337.6
Pascagoula:							
Bulk Grain (export)	1.07	1,137.7	1,189.9	1,244.6	1,272.9	1,272.9	1,272.9
TOTAL		5,475.3	5,527.5	5,582.2	5,610.4	5,610.4	5,610.4

a. <u>Delays Waiting for Daylight</u>: These delays will be discussed separately for each type of vessel.

(1) **Crude and grain.** The delays waiting for daylight associated with the existing width of the bar for lightering vessels were discussed in paragraphs 50 and 51 and in Table 35A. The delays for the grain vessels are also shown on Table 35A. The maximum delay for grain is 14 hours on their outbound leg; they are waiting at the docks to exit the channel because of the narrow bar. Delays remain for the crude lighters if a turning basin is not provided with a widened bar. Since the grain vessels turn in the turning basin provided in the Pascagoula River channel, they are not affected by the problems existing in the existing turning basin at Bayou Casotte. No delays remain for grain ships if only the bar were widened. The grain vessels can travel the channel as soon as the Bayou Casotte vessels finish traveling the main portion of the channel (Dock 7 to the bar and vice-versa).

(2) **Coke and Finished Product Tankers.** The delays because of the bar for coke vessels and finished products tankers are more extensive--they are delayed on both legs. See Table 37A for a summary of these calculations. The inbound leg of these two types of vessels is delayed more than the outbound leg. The slowest speeds for these large dry bulk carriers is 6 to 7 knots which presents hazardous conditions for chemical tankers moored and loading at Docks 3 or 5. The deeper the draft, the greater the risk of damage and even catastrophe within the inner harbor. In summary, these two types of vessels must comply with the 3 restrictions imposed by the harbor pilots which are discussed in paragraph 49. The result is that the harbor pilots must turn these vessels before loading, and this adds several hours to the maximum wait at the bar if enough daylight does not exist to travel the channel, turn and get to the appropriate dock before 6:00 p.m. These vessels are also delayed by the NuSouth vessels which must be shifted from the turning basin for them to turn. The average delays for the inbound leg is 5.34 hours, and 4.08 for the outbound leg.

The second half of Table 37A shows the residual delays with a widened bar and no turning basin. There is no change in the delays for these inbound empty vessels, and all delays are eliminated for the outbound leg.

(3) **Lash and RoRo Vessels.** These vessels must comply with two of the restrictions of the harbor pilots discussed in paragraph 49 for delays waiting for daylight--crossing the bar and passing Docks 1-5. The calculations for these delays are shown in Table 37B. These vessels are too long to be turned in the existing turning basin; they are "nosed" into the existing turning basin and backed into the slip between Piers F and G.

TABLE 37A

Delays to Petroleum Coke Vessels and Finished Product Tankers
Operating at Bayou Casotte Inner Harbor
Without-Project Condition

PERIOD OF DELAY:	Operations	Maximum Delay	Avg. Delay	Probability of Delay	Hours Delayed
	-----------At Bar/Pass and Turning Basin Combined----------				
Arrivals @ Seabouy					
		------------(Inbound - Empty)-----------			
2:30 pm - 6:00 am	Turned (bow south) is the only option	15.5	7.75	0.6458	5.01
6:00 am - 2:30 pm	Additional Wait for pilot/tug callout for NuSouth vessels	2.5	1.25	0.267	0.33
					5.34
Waiting @ Docks		------------(Outbound - Loaded)----------			
4:00 pm - 6:00 am	Turned (bow south)	14	7	0.5833	4.08
					9.42
	---------Residual Delays with Bar Widening Only------------				
Arrivals @ Seabouy		------------(Inbound - Empty)-----------			
2:30 pm - 6:00 am	Turned (bow south) is the only option	15.5	7.75	0.6458	5.01
6:00 am - 2:30 pm	Additional Wait for pilot/tug callout for NuSouth vessels	2.5	1.25	0.267	0.33
					5.34
Waiting @ Docks		------------(Outbound - Loaded)----------			
4:00 pm - 6:00 am	Turned (bow south)	0	0	0.5833	0.00
					5.34

Note: Minimal speed for these dry bulk carriers and tankers is 6-7 knots. While passing the finished products docks, the lesser the draft the lesser risk of damage to tankers moored at F. P. docks (breaking lines, damaging piers and vessels and causing explosions).
The probability of delay caused by NuSouth shifts was based on their pier utilization rate (8/30, or .266
All 5.34 hours residual delays waiting for daylight will be eliminated when a new turning basin is added.

TABLE 37B
Delays to Lash and RoRo Vessels
Operating at Bayou Casotte Inner Harbor
Without-Project Condition

Period of Delay	Operations	Maximum Delay	Avg. Delay	Probability of Delay	Hours Delayed
		At Bar/Pass and Turning Basin Combined			
		(Inbound - Loaded)			
3:45 pm - 6:00 am	Arrivals @ seabuoy: Travel channel & pass by Docks 3 & 5	14.25	7.125	0.5948	4.24
		(Outbound - Loaded)			
3:45 pm - 6:00 am	Departure from docks: Pass Docks 3 & 5 & travel channel	14.25	7.125	0.5948	4.24
					8.48
		Residual Delays with Bar Widening Only			
		(Inbound - Loaded)			
3:45 pm - 4:00 am	Arrivals @ seabuoy: Travel channel & pass by Docks 3 & 5	12.25	6.125	0.5104	3.13
		(Outbound - Loaded)			
5:45 pm - 6:00 am	Departure from docks: Pass Docks 3 & 5 & travel channel	12.25	6.125	0.5104	3.13
					6.25
	Hours saved with widening				2.22

Note: Harbor pilots require that these vessels pass Chevron's finished products docks only in daylight because of their speed (minimal 6-7 knots) and length coupled with freeboard (containers aboard). They are too long to turn in the existing turning basin; they are nosed into it and then backed into the slip between Warehouses 6 & F and serviced by these two warehouses. There are no benefits to a new turning basin; however, a widened bar would open their operating 2 hours on each end of the trip.

Since they <u>must</u> pass Docks 1-5 only in daylight because of their length with added freeboard from containers, the window of daylight operating hours can only be increased 2.0 hours on each end of their voyage into the harbor. This is based on two hours needed to travel the channel and 15 minutes to travel the distance from Dock 7 to Dock 3 inbound or from the slip between Warehouses F and G to just past Dock 5 outbound within the daylight window of 6:00 a.m. to 6:00 p.m.

The following display summarizes the average delays waiting for daylight associated with the existing narrow bar and an inefficient turning basin for each type of vessel using each channel:

	Reduced Delays (hours)		
	Bar + T. B.	Bar	T. B.
Bayou Casotte:			
Crude Lighters	4.42	3.95	0.47
Finished Prod. tankers	9.42	4.08	5.34
Coke Vessels	9.42	4.08	5.34
Lash	2.22	2.22	0
RoRo	2.22	2.22	0
Pascagoula River:			
Grain vessels	4.08	4.08	0

The number of vessels expected to use each harbor under without-project and with-project conditions shall be discussed. The Bayou Casotte Inner Harbor shall be discussed first. This discussion assumes that widening the bar and pass and providing a new turning basin at Bayou Casotte shall be a singular alternative.

(a) Bayou Casotte Inner Harbor Vessels. The crude lighter vessels for Chevron have been discussed and their number of trips and hours of delay waiting for daylight because of maneuvering difficulties across the bar and pass channel are shown on Table 35. Coke vessels of loaded drafts applicable to 38, 40, 42 and 44-foot channels will number 32, 29, 26 and 24 per year, respectively, for these channels based on Corps guidance for each class of drybulk carriers utilizing each of the channel depths. The numbers of finished product tankers transporting export chemicals for each channel depth were furnished by Chevron. They number 12 for without-project condition and 11 for the 40', 42' and 44'channel depths. There will be 9 large lash and 8 RoRo vessels using each of the channel depths considered.

(b) Pascagoula Inner Harbor Vessels. Grain vessels with drafts at or greater than 34 feet will number 50 for without-project condition and 40, 30 and 25 for 40, 42 and 44-foot channels, respectively, on an annual basis with the project. Smaller RoRo's will number 3 per year (Table 16) in the future; these are not included in the benefit calculations for widening the bar and pass since their drafts do not exceed current draft restrictions.

b. Fleet Interaction Delays. A queuing analysis was needed for calculating these interaction delays; however, the following analysis is an approximation of the benefits. These are generated from vessels waiting on each other to use the channel during the night. (Daytime interaction delays under without-project condition would remain with the widening and new turning basin alternatives.) There are three cases at night when these delays occur: Case 1 is where two vessels arrive at the bar at the same time ready to come into the harbor; Case 2 is where two vessels finish inside the harbor at night and both are ready to leave their docks at the same time; and Case 3 is where one is at the bar and one is at the docks at night and both are ready to use the channel. These situations shall be discussed in the order listed.

In this analysis, a total of 325 ships were used to determine the amount of delay to assign to each case under without-project condition on an annual basis. This includes 231 crude lighters, 32 petroleum coke dry bulk carriers, 50 grain ships, and 12 finished product tankers which would be trying to simultaneously use the channel (lash and RoRo vessels were excluded since they call so infrequently at this harbor). Two assumptions are critical to this analysis: 1) random arrivals at the bar and at the docks are uniformly distributed; and 2) the daytime operating window was 8.5 hours (2:30 p.m. was the cutoff for traveling the channel and getting turned at Bayou Casotte) for Cases 1 and 3 and 10 hours for Case 2.

(1) **Case 1: Two Ships Waiting at the Bar:** If arrivals are uniformly distributed, then the probability of arrival at night is 15.5/24 or 0.645; therefore 210 ships arrive at night over the year (0.645 * 325 ships). Assume that the probability of a ship arriving on any given night is the same. Then, for any given night, the probability that a ship arrives on that night is 1/365; conversely, the probability that it arrives on some other night is 364/365. With 210 ships arriving at night, the probability that no ships will arrive on any night is $(364/365)^{210}$, or 0.56. Therefore, ships do arrive on 0.44*365, or 161 days of the year. Since 210 ships arrive altogether, the number of ships that arrive at night when one is already there at the bar is 210-161, or 49. The probabilities of night arrivals for the 40', 42' and 44' alternatives are 0.42, 0.41 and 0.40,

respectively, because the number of ships decrease with each successively deeper channel alternative.

The delays associated with two or more ships arriving at the bar on any given night when a ship is already there was explored using a Poisson approximation as follows, where P = Probability approximation. The sum of the nights when 2 or more ships are waiting shown in this Poisson approximation equals the calculations in the previous paragraph, excluding rounding errors:

P(0) = 0.562 of 205.2 nights with no ships arriving;
P(1) = 0.324 of 118.1 nights with 1 ship arriving;
P(2) = 0.093 of 33.9 nights with 2 ships arriving;
P(3) = 0.018 of 6.5 nights with 3 ships arriving;
P(4) = 0.003 of 1.1 nights with 4 or more ships arriving.

However, no further effort was made to claim additional delays based on 3 or more ships arriving at the bar on any given night when another was already there.

(2) **Case 2: Two vessels Waiting at the Docks**: For the probability of one ship finishing unloading (or loading) at night and another being ready at the docks to sail during that same hour during the night, the assumption must be made that ship departures are also uniformly distributed like the arrivals at the bar. The same arguments for two ships arriving at the bar as in Case 1 are applied; however, the window of daylight operations is now 10 hours since only 2 hours are required to travel the channel on the outbound leg. The number of vessels which would be delayed would have to be reduced considerably, since the empty crude lighters travel over the bar during night under the existing condition. For the without-project condition (38') and the 40', 42' and 44' alternatives, 94, 70, 67 and 60 ships, respectively, will be ready to sail at night when another ship is already there and one or the other will be delayed on their outbound leg. Using the same procedure as in Case 1, the probabilities of 2 or more ships which need to exit the channel at the same time under without-project condition are 0.14. For the 40', 42' and 44' alternatives, this probability drops to 0.11 for the first two deepening alternatives and 0.02 for the 44' alternative. These probabilities equate to one ship being delayed for the 40' alternative and none for the 42' and 44' alternatives.

(3) **Case 3: One Vessel Waiting at both the Bar and Dock:** The probability that a ship arrives at the bar on any given night is 0.44 (see Case 1) for the without-project condition. Likewise, if we assume that the ships spend about the same time at the dock, the probability that a ship which might be delayed in leaving the docks is described in Case 2, or 0.14 for without-project condition. Therefore, the probability that these two

ents coincide is 0.44*0.14 or 0.06. This translates to 06*365, or 22 nights when this happens under without-project ndition; 0.42*0.11, or 17 nights for the 40' alternative; and 41*0.11, or 16.5 nights for the 42' alternative and 0.40*0.C2 3 nights for the 44' alternative. Table 37C shows the results the fleet interaction delays during night.

In summary, 75 ships are delayed annually during the night this harbor because another ship is using the channel under e without-project condition for all three cases. An <u>average lay</u> for all three cases was calculated based on 3.5 hours for se 1 except for grain vessels. The grain vessels wait only 2 urs for a Bayou Casotte vessel to clear the channel (bar to ck 7 at Bayou Casotte and vice-versa). For Case 2, only two urs was used since this is the amount of time required to avel the channel outbound. For Case 3, the inbound loaded ghter encompasses 71 percent of the total fleet and has iority over any outbound vessel. Consequently, the outbound ip must wait a maximum of 3.5 hours for the lighter to complete s entire leg. The outbound vessels have little or no delays as own in Case 2; therefore, the average delay for Case 3 is 2.5 urs (3.5 hours x 0.7108) for without-project condition. These ximum delays for each case were summed (8 hours) and then vided by the 3 cases for an average delay of 2.67 hours for all cases. To summarize the without-project condition delays, 2.67 urs of delay at night are incurred by 75 ships from their teraction with each other.

There are interaction delays which will remain at night for ese 75 ships with a widened bar and a new turning basin. For th-project condition remaining delays, the maximum <u>delay window</u> s calculated on each hour of the day for Case 1, Case 2 and se, since random arrivals were assumed. These are 3.5, 2.0 and 5 hours for the three cases. A fraction was generated for each the cases which represents the old night window (the nominator) and the new night window (the divisor). The new th-project night window will be increased to 12 hours. The old thout-project night window was 15.5 hours (12 + 3.5) for Case For Case 2, the old window was 14 hours (12 + 2); and for se 3, the old window was the same as Case 1. These fractions re summed, averaged and then squared for the three cases, and eir total subtracted from one to obtain the remaining obability with a widened bar and a new turning basin. The thematical equation is as follows: $1 - ((12/15.5 + 12/14$ $2/14.5)/3)^2$. This resultant equation was 1.00 - 0.67, or 0.33 obability that the total average delay in Cases 1, 2 and 3 uld remain with the widened bar and a new turning basin. This obability was used to multiply the average delay (2.67/2, or 34 hours) for each vessel type and then subtracted from the tal without-project delay of 2.67 hours. Table 37C shows the lculations for these remaining and reduced delays from fleet teractions.

TABLE 37C

Benefits from Reduced Interaction Delays During Night With a Widened Bar and a New Turning Basin

1 October 1991 Prices

Reduced Interaction Delays @ Night @ 38'

Type Vessel	% of 325 Vessels	# Vessels Delayed	Without-Project Delay	With-Project Delay: Max. Delay	Avg. Delay	(P) of Remain. Delay	Remain. Delay	Reduced Hours /trip	Hours /yr	$ /hr	Reduced Delays ($)
Crude Lighter	0.711	53.3	2.67	2.67	1.34	0.33	0.44	2.23	118.8	1098	97,870
Coke	0.098	7.4	2.67	2.67	1.34	0.33	0.44	2.23	16.5	497	8,182
Fin. Prod. Tankers	0.037	2.8	2.67	2.67	1.34	0.33	0.44	2.23	6.2	628	3,877
Grain	0.154	11.5	2.00	2.00	1.00	0.33	0.33	1.67	19.3	519	10,001
	1.000	75.0							160.8		119,931

Reduced Interaction Delays @ Night @ 40'

Type Vessel	% of 311 Vessels	# Vessels Delayed	Without-Project Delay	With-Project Delay: Max. Delay	Avg. Delay	(P) of Remain. Delay	Remain. Delay	Reduced Hours /trip	Hours /yr	$ /hr	Reduced Delays ($)
Crude Lighter	0.743	49.0	2.67	2.67	1.34	0.33	0.44	2.23	109.3	1098	90,003
Coke	0.093	6.2	2.67	2.67	1.34	0.33	0.44	2.23	13.7	497	6.819
Fin. Prod. Tankers	0.035	2.3	2.67	2.67	1.34	0.33	0.44	2.23	5.2	628	3,268
Grain	0.129	8.5	2.00	2.00	1.00	0.33	0.33	1.67	14.2	519	7,357
	1.000	66.0							142.4		107,448

Reduced Interaction Delays @ Night @ 42'

Type Vessel	% of 298 Vessels	# Vessels Delayed	Without-Project Delay	With-Project Delay: Max. Delay	Avg. Delay	(P) of Remain. Delay	Remain. Delay	Reduced Hours /trip	Hours /yr	$ /hr	Reduced Delays ($)
Crude Lighter	0.775	45.3	2.67	2.67	1.34	0.33	0.44	2.23	101.1	1098	83,255
Coke	0.087	5.1	2.67	2.67	1.34	0.33	0.44	2.23	11.4	497	5,655
Fin. Prod. Tankers	0.037	2.2	2.67	2.67	1.34	0.33	0.44	2.23	4.8	628	3,023
Grain	0.101	5.9	2.00	2.00	1.00	0.33	0.33	1.67	9.8	519	5,104
	1.000	58.5							127.1		97,039

Reduced Interaction Delays @ Night @ 44'

Type Vessel	% of 291 Vessels	# Vessels Delayed	Without-Project Delay	With-Project Delay: Max. Delay	Avg. Delay	(P) of Remain. Delay	Remain. Delay	Reduced Hours /trip	Hours /yr	$ /hr	Reduced Delays ($)
Crude Lighter	0.794	35.7	2.67	2.67	1.34	0.33	0.44	2.23	79.6	1098	65,583
Coke	0.082	3.7	2.67	2.67	1.34	0.33	0.44	2.23	8.3	497	4,112
Fin. Prod. Tankers	0.038	1.7	2.67	2.67	1.34	0.33	0.44	2.23	3.8	628	2,382
Grain	0.086	3.9	2.00	2.00	1.00	0.33	0.33	1.67	6.5	519	3,351
	1.000	45.0							98.2		75,428

Note: The fleet of vessels which will be delayed is smaller with each successively deeper channel (larger vessels).
Only 75% of the crude lighter hours reduced were claimed.
Probabilities of remaining delays during the night is 0.33, or $1 - ((12/15.5+12/14+12/14.5)/3)^2$.

In addition to waiting for daylight and interaction delays shown in the previous paragraph, the harbor pilots and Chevron personnel attached a 0.5 average weather delay to all of the larger ships shown in Table 38. High wind and currents cause high waves, and high waves affect vessel maneuverability and bottom clearance while crossing the bar. If either of these conditions exist, the safety of the vessel is threatened. This condition has caused vessels to wait at the bar for a day or more until the ship can safely cross the bar.

60. Table 38 summarizes the benefits for widening the bar and pass which amount to $1,282,223 for the existing 38′ channel. Tables 38A, 38B and 38C show that the benefits are $1,179,464, $1,101,810 and $1,063,762, respectively, for the 40′, 42′ and 44′ channel deepening alternatives. These benefits assume that the bar and pass are widened along with a new turning basin constructed at Bayou Casotte. The reason the benefits decrease for each successively deeper alternative is that fewer trips (larger vessels) are required with each deeper channel alternative for each type of vessel, except for lash and RoRo.

61. <u>Benefits to a New Turning Basin at Bayou Casotte</u>. Table 39 shows the calculations to a new turning basin if it is combined with widening the bar. There are several categories of benefits for a new turning basin. These are: a) reduced vessel travel time; b) synergistic delay reductions when combined with a widened bar; c) reduced NuSouth, Inc. vessel shifts; and d) reduced tug costs. These shall be discussed in this order.

a. **Reduced Vessel Travel Time.** Crude tankers and coke vessels must travel at minimum speeds a congested mile passing hazardous chemical loading docks (Docks 3 and 5) to a turning basin north of the public warehouses and turn and return along this same hazardous, congested route. Using the data presented in Table 34, the crude lighters′ time to travel to/from the turning basin and turn is 1.5 hours. Based on data from the harbor pilots and Chevron personnel, this time will be reduced to 0.5 hours with the new turning basin adjacent and across from Docks 6 and 7. This savings in time is due to the fact that <u>all</u> travel will be eliminated; the vessels turning time will remain 0.5 hours. Night turns will also be allowed. The coke vessels travel almost the same distance and require 1.35 hours for the same maneuver. Finished products tankers carrying Chevron′s finished product chemical products would require 1.0 hours for the same maneuver. With the new turning basin adjacent and across from Docks 7 and 6, the coke vessels would be turned empty and backed north to the coke dock which would consume some of the time previously consumed as travel time to the old turning basin. The same backing-up process would occur for the finished products tankers at Dock 5. Accordingly, only .50 hours were saved per trip for the coke vessels. No travel time will be saved by the finished products tankers--they are located equidistant between

TABLE 38
BENEFITS FOR WIDENING THE BAR AND PASS AT 38'
WITHOUT-PROJECT CONDITION
1 October 1991 Prices

	38'						
		Hours					
Type Vessels:	# Trips per year	Waiting For Daylight	Reduc. Interact. Delays	For Weather	Total /trip	$ /hr ($)	Total Savings ($)
WAITING FOR DAYLIGHT:							
Lighter (crude)	230.5	3.95	----	0.5	1,025.7	1,098	844,685
Lighter (fuel savings)							15,628
Coke	32.0	4.08	----	0.5	146.6	497	72,840
Fin. Prod.(Tankers)	12.0	4.08	----	0.5	55.0	628	34,515
Lash (large)	9.0	2.22	----	0.5	24.5	1,514	37,063
RoRo (large)	8.0	2.22	----	0.5	21.8	1,779	38,711
Subtotal	291.5				1,273.5		1,043,441
INTERACTION DELAYS:							
Lighter (crude)	53.3	----	2.23	----	118.8	1,098	97,870
Coke	7.4	----	2.23	----	16.5	497	8,182
Fin. Prod.(Tankers)	2.8	----	2.23	----	6.2	628	3,877
Subtotal	63.5				141.5		109,930
Total for Bayou Casotte							1,153,371
WAITING FOR DAYLIGHT:							
Grain	50.0	4.08	----	0.5	229.0	519	118,851
INTERACTION DELAYS:							
Grain	11.5	----	1.67	----	19.3	519	10,001
Total for Pasca. River	61.5				248.3		128,852
TOTAL - BOTH CHANNELS							1,282,223

Note: Totals may not sum due to rounding.
Some of these benefits are generated only when combined with a new turning basin.
Only 75% of the lighters hours waiting are claimed for outchartering.
For computing the number of ships waiting during daylight, apportionments were made for each type of vessel relative to their share of the 325 large ships using the channel annually (example: 230.5/325 = .711*75 ships waiting during the night = 53.3 crude ships).
Probabilities of remaining delays during the night are 0.33, or 1-((12/15.5+12/14+12/14.5)/3)2.
See Table 37C for calculations of remaining delays.

TABLE 38A
BENEFITS FOR WIDENING THE BAR AND PASS AT 40'
WITH-PROJECT CONDITION
1 October 1991 Prices

	40'						
		Hours					
Type Vessels:	# Trips per year	Waiting for Daylight	Reduc. Interact. Delays	For Weather	Total /trip	$ /hr ($)	Total Savings ($)
WAITING FOR DAYLIGHT:							
Lighter (crude)	215.0	3.95	----	0.5	956.8	1,098	787,884
Lighter (fuel savings)							15,628
Coke	29.0	4.08	----	0.5	132.8	497	66,012
Fin. Prod.(Tankers)	11.0	4.08	----	0.5	50.4	628	31,639
Lash (large)	9.0	2.22	----	0.5	24.5	1,514	37,063
RoRo (large)	8.0	2.22	----	0.5	21.8	1,779	38,711
Subtotal	272.0				1,186.2		976,936
INTERACTION DELAYS:							
Lighter (crude)	49.0	----	2.23	----	109.3	1,098	90,003
Coke	6.2	----	2.23	----	13.7	497	6,819
Fin. Prod.(Tankers)	2.3	----	2.23	----	5.2	628	3,268
Subtotal	57.5				128.2		100,091
Total for Bayou Casotte							1,077,026
WAITING FOR DAYLIGHT:							
Grain	40.0	4.08	----	0.5	183.2	519	95,081
INTERACTION DELAYS:							
Grain	8.5	----	1.67	----	14.2	519	7,357
Total for Pasca. River:	48.5				197.4		102,438
TOTAL - BOTH CHANNELS							1,179,464

Note: Totals may not sum due to rounding.
Some of these benefits are generated only when combined with a new turning basin.
Only 75% of the lighters hours waiting are claimed for outchartering.
For computing the number of ships waiting during daylight, apportionments were made for each type of vessel relative to their share of the 311 large ships using the channel annually (example: 230.5/311 = .743*66 ships waiting during the night = 49 crude ships).
Probabilities of remaining delays during the night are 0.33, or 1 -((12/15.5+12/14+12/14.5)/3)2.

TABLE 38B
BENEFITS FOR WIDENING THE BAR AND PASS AT 42'
WITH-PROJECT CONDITION
1 October 1991 Prices

	42'						
		Hours					
Type Vessels:	# Trips per year	Waiting for Daylight	Reduc. Interact Delays	For Weather	Total /trip	$ /hr ($)	Total Savings ($)
WAITING FOR DAYLIGHT:							
Lighter (crude)	205.0	3.95	----	0.5	912.3	1,098	751,238
Lighter (fuel savings)							15,628
Coke	26.0	4.08	----	0.5	119.1	497	59,183
Fin. Prod.(Tankers)	11.0	4.08	----	0.5	50.4	628	31,639
Lash (large)	9.0	2.22	----	0.5	24.5	1,514	37,063
RoRo (large)	8.0	2.22	----	0.5	21.8	1,779	38,711
Subtotal	259.0				1,128.0		933,461
INTERACTION DELAYS:							
Lighter (crude)	45.3	----	2.23	----	101.1	1,098	83,255
Coke	5.1	----	2.23	----	11.4	497	5,655
Fin. Prod.(Tankers)	2.2	----	2.23	----	4.8	628	3,023
Subtotal	52.6				117.3		91,934
Total for Bayou Casotte							1,025,395
WAITING FOR DAYLIGHT:							
Grain	30.0	4.08	----	0.5	137.4	519	71,311
INTERACTION DELAYS:							
Grain	5.9	----	1.67	----	9.8	519	5,104
Total for Pasca. River:	35.9				147.2		76,415
TOTAL - BOTH CHANNELS							1,101,810

Note: Totals may not sum due to rounding.
Some of these benefits are generated only when combined with a new turning basin.
Only 75% of the lighters hours waiting are claimed for outchartering.
For computing the number of ships waiting during daylight, apportionments were made for each type of vessel relative to their share of the 298 large ships using the channel annually (example: 230.5/298 = .775*58.5 ships waiting during the night = 45.3 crude ships).
Probabilities of remaining delays during the night are 0.33, or 1 -((12/15.5+12/14+12/14.5)/3)2.

TABLE 38C
BENEFITS FOR WIDENING THE BAR AND PASS AT 44'
WITH-PROJECT CONDITION
1 October 1991 Prices

	----------------------------44'----------------------------						
		-----------Hours----------					
Type Vessels:	# Trips per yr	Waiting For Daylight	Reduc. Interact. Delays	For Weather	Hours Delay/yr	$ /hr ($)	Total Savings ($)
WAITING FOR DAYLIGHT:							
Lighter (crude)	205.0	3.95	----	0.5	912	1,098	751,238
Lighter (fuel savings)							15,628
Coke	24.0	4.08	----	0.5	110	497	54,630
Fin. Prod.(Tankers)	11.0	4.08	----	0.5	50	628	31,639
Lash (large)	9.0	2.22	----	0.5	24	1,514	37,063
RoRo (large)	8.0	2.22	----	0.5	22	1,779	38,711
	-------				-------		---------
Subtotal	257.0				1,119		928,909
INTERACTION DELAYS:							
Lighter (crude)	35.7	----	2.23	----	80	1,098	65,583
Coke	3.7	----	2.23	----	8	497	4,112
Fin. Prod.(Tankers)	1.7	----	2.23	----	4	628	2,382
	-------				-------		---------
Subtotal	41.1				92		72,077

Total for Bayou Casotte							1,000,986
WAITING FOR DAYLIGHT:							
Grain	25.0	4.08	----	0.5	115	519	59,426
INTERACTION DELAYS:							
Grain	3.9	----	1.67	----	6	519	3,351
	-------				-------		-------
Total for Pasca. River:	28.9				121		62,776

TOTAL - BOTH CHANNELS							1,063,762

Note: Totals may not sum due to rounding.
Some of these benefits are generated only when combined with a new turning basin.
Only 75% of the lighters hours waiting are claimed for outchartering.
For computing the number of ships waiting during daylight, apportionments were made for each type of vessel relative to their share of the 291 large ships using the channel annually (example: 230.5/291 = .794*45 ships waiting during the night = 35.7 crude ships).
Probabilities of remaining delays during the night are 0.33, or 1 -((12/15.5+12/14+12/14.5)/3)2.

TABLE 39
SAVINGS TO A NEW TURNING BASIN AT BAYOU CASOTTE (WHEN COMBINED WITH A WIDENED BAR/PASS)
(1 October 1991 Prices)

38'

	Hours/trip: For Travel	Hours/trip: Waiting for Daylight	Hours/trip: Total	Trips /yr	$ /hr	Total $
Crude Outcharters	1.00	0.47	1.47	230.5	1,098	277,054
Crude-Fuel Savings						5,209
Coke vessels	0.50	5.34	5.84	32.0	646	120,724
Fin. Prod. Tankers	0.00	5.34	5.34	12.0	771	49,406
	Reduced Shifts/Mo.			Shifts /yr	$ /shift	Total $
NuSouth tankers	10			120	4,000	480,000
	Trips /yr				$/tug /trip	Total $
Tug Sav. (lighters)	231				1,200	276,600
TOTAL						1,208,993

40'

	Hours/trip: For Travel	Hours/trip: Waiting for Daylight	Hours/trip: Total	Trips /yr	$ /hr	Total $
Crude Outcharters	1.00	0.47	1.47	214.7	1,098	259,904
Crude-Fuel Savings						5,209
Coke vessels	0.50	5.34	5.84	29.0	686	116,181
Fin. Prod. Tankers	0.00	5.34	5.34	11.0	806	47,344
	Reduced Shifts/Mo.			Shifts /yr	$ /shift	Total $
NuSouth tankers	10			120	4,000	480,000
	Trips /yr				$/tug /trip	Total $
Tug Sav. (lighters)	231				1,200	276,600
TOTAL						1,185,238

42'

	Hours/trip: For Travel	Hours/trip: Waiting for Daylight	Hours/trip: Total	Trips /yr	$ /hr	Total $
Crude Outcharters	1.00	0.47	1.47	204.7	1,098	247,799
Crude-Fuel Savings						5,209
Coke vessels	0.50	5.34	5.84	26.0	714	108,414
Fin. Prod. Tankers	0.00	5.34	5.34	11.0	857	50,340
	Reduced Shifts/Mo.			Shifts Per Yr	$ /shift	Total $
NuSouth tankers	10			120	4,000	480,000
	Trips /yr				$/tug /trip	Total $
Tug Sav. (lighters)	231				1,200	276,600
TOTAL						1,168,362

44'

	Hours/trip: For Travel	Hours/trip: Waiting for Daylight	Hours/trip: Total	Trips /yr	$ /hr	Total $
Crude Outcharters	1.00	0.47	1.47	204.7	1,098	247,799
Crude-Fuel Savings						5,400
Coke vessels	0.50	5.34	5.84	24.0	741	103,859
Fin. Prod. Tankers	0.00	5.34	5.34	11.0	905	53,160
	Reduced Shifts/Mo.			Shifts Per Yr	$ /shift	Total $
NuSouth tankers	10			120	4,000	480,000
	Trips /yr				$/tug /trip	Total $
Tug Sav. (lighters)	231				1,200	276,600
TOTAL						1,166,817

Note: Lightering savings are reduced to 75% for outchartering (see Table 35).
$1200 per tug per voyage are based on data furnished by Chevron Shipping, San Francisco.
Totals may not sum due to rounding.

the existing and the proposed new turning basin. In summary, only the lighters, finished products tankers and coke vessels will use the new turning basin. All other vessels either load or unload their cargoes at warehouses E-H or at NuSouth, Inc. (which owns and operates its own docking/loading facilities on the east side of the turning basin). These latter vessels must use the existing turning basin.

b. **Reduced Delays When Combined with a Widened Bar:** Based on data presented in Tables 35A, 37A and 37B, small delays remain for crude lighters (see Table 35A) and extensive delays remain for coke and finished product tankers (see Table 37A) and for lash and RoRo vessels (see Table 37B). However, when a new turning basin is combined with the widened bar, all these delays are eliminated, except for those associated with the lash and RoRo vessels. These reduced delays were assigned as benefits to a new turning basin. These calculations are shown in Table 39.

c. **Reduced NuSouth, Inc. Vessel Shifts:** NuSouth Industries, Inc., a fertilizer manufacturer, is located east and adjacent to the turning basin and has its loading and unloading docks located on the east side of the turning basin. Because of the length (785 feet) and dangerous cargo of particularly the crude tankers during turning, <u>all</u> NuSouth tankers must be shifted to piers E-H before the larger ships can be turned. Based on data from NuSouth and the harbor pilots, ten of NuSouth's vessels must be shifted per month at an average cost of $4,000 per shift (pilots, tugs, linesmen, crew, dockage, etc.). In most cases, these shifts involve tankers loading liquid ammonia ("DAP") which takes 3 to 6 days to load. Extra care must be taken by NuSouth and the pilots to ensure safety, e.g., the same vessel may be shifted five times. These costs will be avoided with a new turning basin.

d. **Reduced Tug Costs:** Only the crude tankers will have a reduction in tugs costs for each trip. Two tugs are required for the lighter inside the inner harbor to assist while loaded (or empty), traveling past Docks 3 and 5 where hazardous materials are being loaded, turn, and return again passing Docks 3 and 5 and dock. Based on Chevron data, $1,200 per voyage in tug costs will be eliminated when a new turning basin is placed across from Docks 6 and 7. These tug savings are presented in Table 39. All the above categories of benefits to a new turning basin are summarized in Table 39. To summarize, there are $1,208,993 in benefits to constructing a new turning basin at the existing 38' depth, and $1,185,238, $1,168,362 and $1,166,817, respectively, to the 40', 42' and 44' channel depths.

62. Inefficiencies would remain if the new turning basin is not combined with widening the bar and pass. For example, a substantial reduction in delays for coke vessels and finished product tankers is attributable to the turning basin (5.34

hours). No differences in reductions of delays for grain are attributable to the turning basin, as grain vessels use the Pascagoula River channel turning basin. The crude lighters have a 0.46 residual delay if the turning basin is not combined with the widened bar. For lash and RoRo vessels, no delays are attributable to the turning basin--they do not use the existing turning basin, nor will these ships use the new one. See Table 39A for the results of these computations for a turning basin if constructed singularly.

63. Two items would occur whether the turning basin were constructed singularly or combined with the bar widening--reductions in vessel shifts by the NuSouth tankers and reductions in tug costs for the lighters.

65. <u>Summary</u>. Table 40 summarizes the benefits for deepening the channel, widening the bar and pass and providing a new turning basin singularly and combined on an average annual equivalent basis for the 40, 42, and 44-foot channel depths.

TABLE 39A

BENEFITS TO WIDENING THE BAR OR PROVIDING A NEW TURNING BASIN SEPARATELY
(1 October 1991 Prices)

Type Vessels	Widen Bar Solely at 38'						
		Hours					
	# trips /yr	Waiting for Daylight	Reduc. Interact. Delays	For Weather	Total /yr	*In port $/hour	Total Savings
WAITING FOR DAYLIGHT:							
Lighters (crude)	230.5	3.95	---	0.50	769	1,098	844,685
Lighter Fuel Savings							15,628
Coke	32.0	4.08	---	0.50	147	497	72,840
Finished Products tankers	12.0	4.08	---	0.50	55	628	34,515
Lash (large)	9.0	2.22	---	0.50	24	1,514	37,063
RoRo (large)	8.0	2.22	---	0.50	22	1,779	38,711
Subtotal	291.5				1,017		1,043,441
INTERACTION DELAYS:							
Lighters (crude)	53.3	----	2.23	----	89	1,098	97,870
Coke	7.4	----	2.23	----	16	497	8,182
Finished Products tankers	2.8	----	2.23	----	6	628	3,877
Subtotal	63.5				112		109,930
Total for Bayou Ca.otte							1,153,371
Grain, Waiting for Daylight	50.0	4.08	---	0.50	229	519	118,851
Grain, Interation Delays	11.5	----	1.67	----	19	519	10,001
Total for Pasca. River	61.5				248		128,852
TOTAL FOR BOTH CHANNELS							1,282,223

Type Vessels	Provide a New Turning Basin Solely at 38'					
		Hours				
	Travel Time	Waiting for D.L.	Total Hrs/trip	# Trips	$ /hr	Total Savings
Lighters (crude)	1.00	0.46	1.46	230.5	1,098	92,377
Lighter Fuel Savings						5,209
Coke vessels	0.50	5.34	5.84	32	646	120,724
Finished Products tankers	0.00	5.34	5.34	12	771	49,406
	Shifts/Mo.			Shifts/yr	$/shift	$/yr
Reduced NuSouth Vessel Shifts	10			120	4,000	480,000
	Trips/yr				$ Sav./t	$/yr
Lighters (crude)	230.5				1,200	276,600
TOTALS						1,024,317

Note: For lighters, 75% of savings are claimed for widening the bar and 25% for a new turning basin.
Probabilities of delays remaining during the night are 0.33, or 1 - ((12/15.5+12/14+12/14.5)/3)2.

TABLE 40
SUMMARY - AVERAGE ANNUAL EQUIVALENT TRANSPORTATION BENEFITS
FOR ALTERNATIVE CHANNEL DEPTHS AND OTHER FEATURES
PASCAGOULA HARBOR
(1 October 1991 Prices; 8 3/4 % Interest)
($1,000)

	38' Widen Bar	38' New T.B.	38' Widen Bar & New T.B.	PR @ 38' BC @ 40'	PR @ 38' BC @ 40' Widen Bar & New T.B.	PR @ 39' BC @ 40'	PR @ 39' BC @ 40' Widen Bar & New T.B.	PR @ 40' BC @ 40'	PR @ 40' BC @ 40' Widen Bar & New T.B.	PR @ 38' BC @ 42'	PR @ 38' BC @ 42' Widen Bar & New T.B.
DEEPENING:			($)	($)	($)	($)	($)	($)	($)	($)	($)
Bayou Casotte:											
Crude Oil (import)	0	0	0	362.2	362.2	362.2	362.2	362.2	362.2	603.6	603.6
Petroleum Coke (export)	0	0	0	2,003.9	2,003.9	2,003.9	2,003.9	2,003.9	2,003.9	3,142.7	3,142.7
Subtotal	0	0	0	2,366.1	2,366.1	2,366.1	2,366.1	2,366.1	2,366.1	3,746.3	3,746.3
Pascagoula River:											
Bulk Grain (export)	0	0	0	0	0	677.6	677.6	866.8	866.8	0	0
Subtotal	0	0	0	2,366.1	2,366.1	3,043.7	3,043.7	3,232.9	3,232.9	3,746.3	3,746.3
WIDENING BAR/PASS:											
Bayou Casotte Vessels	1,153.3	0	1,153.3	0	1,077.0	0	1,077.0	0	1,077.0	0	1,025.4
Pascagoula River Vessels	128.9	0	128.9	0	102.4	0	102.4	0	102.4	0	76.4
Subtotal	1,282.2	0	1,282.2	0	1,179.4	0	1,179.4	0	1,179.4	0	1,101.8
NEW TURNING BASIN:	0	1,024.3	1,209.0	0	1,185.2	0	1,185.2	0	1,185.2	0	1,168.4
TOTAL	1,282.2	1,024.3	2,491.2	2,366.1	4,730.7	3,043.7	5,408.3	3,232.9	5,597.5	3,746.3	6,016.5

NOTE: "PR" = Pascagoula River; "BC" = Bayou Casotte

TABLE 40 (Cont'd)

	PR @ 39' BC @ 42'	PR @ 39' BC @ 42' Widen Bar & New T.B.	PR @ 40' BC @ 42'	PR @ 40' BC @ 42' Widen Bar & New T.B.	PR @ 38' BC @ 44'	PR @ 38' BC @ 44' Widen Bar & New T.B.	PR @ 39' BC @ 44'	PR @ 39' BC @ 44' Widen Bar & New T.B.	PR @ 40' BC @ 44'	PR @ 40' BC @ 44' Widen Bar & New T.B.
DEEPENING:	($)	($)	($)	($)	($)	($)	($)	($)	($)	($)
Bayou Casotte:										
Crude Oil (import)	603.6	603.6	603.6	603.6	603.6	603.6	603.6	603.6	603.6	603.6
Petroleum Coke (export)	3,142.7	3,142.7	3,142.7	3,142.7	3,734.0	3,734.0	3,734.0	3,734.0	3,734.0	3,734.0
Subtotal	3,746.3	3,746.3	3,746.3	3,746.3	4,337.6	4,337.6	4,337.6	4,337.6	4,337.6	4,337.6
Pascagoula River:										
Bulk Grain (export)	677.6	677.6	866.8	866.8	0	0	677.6	677.6	866.8	866.8
Subtotal	4,423.9	4,423.9	4,613.1	4,613.1	4,337.6	4,337.6	5,015.2	5,015.2	5,204.4	5,204.4
WIDENING BAR/PASS:										
Bayou Casotte Vessels	0	1,025.4	0	1,025.4	0	1,001.0	0	1,001.0	0	1,001.0
Pascagoula River Vessels	0	76.4	0	76.4	0	62.8	0	62.8	0	62.8
Subtotal	0	1,101.8	0	1,101.8	0	1,063.8	0	1,063.8	0	1,063.8
NEW TURNING BASIN:	0	1,168.4	0	1,168.4	0	1,166.8	0	1,166.8	0	1,166.8
TOTAL	4,423.9	6,694.1	4,613.1	6,883.3	4,337.6	6,566.2	5,015.2	7,245.8	5,204.4	7,435.0

NOTE: "PR" = Pascagoula River; "BC" = Bayou Casotte

SENSITIVITY ANALYSIS OF NAVIGATION BENEFITS

66. The benefits shown in Table 40 are sensitive in two major areas: commodity projections and vessel operating costs. Each of these areas shall be addressed below.

67. High/Low Projections of Commerce. Several of the channel users could have technological or demand (population) driven expansions. Each user shall be discussed below.

68. Grain (export). Historically, this commodity is used by the U.S. as a political tool; for example, the Russian grain embargo of the late 1970s and early 1980s. Industrialization of developing or underdeveloped countries is also having a big impact on U.S. grain exports when coupled with self-determination and self-sufficiency policies of these underdeveloped nations (example: China, the EEC and Warsaw Pact nations).

69. Company officials at Louis Dreyfus Corporation felt that their Pascagoula elevator is competitive with New Orleans or Mobile. The non-congested harbor, short channel and relatively low port/handling charges offer major advantages. Their almost parity rail rates with New Orleans barge rates could return this elevator to their 1979 level of 3.8 million tons of export grain with the same or new markets by 1996. This would mean that 2,128,000 tons would be exported to foreign destinations which could utilize larger ships needing drafts greater than 38 feet.

70. The lowest projection of grain would be no growth from the previous nine year average mentioned previously (1,742,015 tons x 54 percent needing greater than 38 feet) or 940,700 tons based on data from Louis Dreyfus Corporation.

71. Crude Oil (import). This technologically efficient and unique refinery runs at capacity with high sulfur crude. A large expansion occurred in 1984 which added facilities to process heavier crude. No growth in the amount of crude imports is expected in the future. However, their existing lightering operations or plant storage facilities could possibly be improved so that the remaining hours saved from delays or waiting by the lighters could be chartered by other companies rather than allowing these tankers to sit idle.

72. Petroleum Coke (export). All (100 percent) of the coke could be exported to destinations in Europe/Mediterranean with channel depths greater than 38 feet based on data from SSM Carbon, Inc., the broker. The worst case scenario would be 65 percent based on data from this company; i.e., Chevron's restrictive practices on vessel sizes and underkeel clearances would maximally affect 35 percent of the tonnage.

3. Ten Percent Increase/Decrease in Vessel Operating Costs. .S. Army guidelines for deep draft vessel operating costs show luctuating operating costs as demand for and supply of these essels change. From year to year, vessel operating costs have luctuated 10 percent higher than the previous year. A 10 ercent decrease is also tested.

4. Summary. Table 41 shows the two scenarios for projections f tonnages. Table 42 shows the results of 10 percent increase nd decrease in vessel operating costs. The 10 percent increase as applied to the high scenario tonnage projections and the 10 ercent decrease was applied to the low tonnage scenario to scertain the maximum and least benefits possible. The avings in Table 42 were discounted to present value, amortized ver the 50-year period 1996-2046, and presented as average nnual equivalent benefits to a 42 foot channel in Table 43.

TABLE 41
HIGH/LOW TONNAGE SCENARIOS - PROJECTIONS OF COMMERCE
PASCAGOULA HARBOR

(1 October 1991 Prices)

HIGH TONNAGE SCENARIO (1,000 SHORT TONS)

	1996	2006	2016	2026	2036	2046
CHANNEL:						
Bayou Casotte:						
Crude Oil (import)	17,246.3	17,245.3	17,246.3	17,246.3	17,246.3	17,246.3
Petroleum Coke (export)	1,460.0	1,460.0	1,460.0	1,460.0	1,460.0	1,460.0
Subtotal	18,706.3	18,706.3	18,706.3	18,706.3	18,706.3	18,706.3
Pascagoula River:						
Bulk Grain (export)	2,128.0	2,128.0	2,128.0	2,128.0	2,128.0	2,128.0
TOTAL	18,722.3	18,722.3	18,722.3	18,722.3	18,722.3	18,722.3

LOW TONNAGE SCENARIO (1,000 SHORT TONS)

	1996	2006	2016	2026	2036	2046
CHANNEL:						
Bayou Casotte:						
Crude Oil (import)	17,246.3	17,246.3	17,246.3	17,246.3	17,246.3	17,246.3
Petroleum Coke (export)	949.0	949.0	949.0	949.0	949.0	949.0
Subtotal	18,195.3	18,195.3	18,195.3	18,195.3	18,195.3	18,195.3
Pascagoula River:						
Bulk Grain (export)	940.7	940.7	940.7	940.7	940.7	940.7
TOTAL	19,136.0	19,136.0	19,136.0	19,136.0	19,136.0	19,136.0

TABLE 42
SENSITIVITY - TRANSPORTATION SAVINGS FOR A 42-FOOT CHANNEL
PASCAGOULA HARBOR
(1 October 1991 Prices)

CHANNEL:	UNIT SAVINGS ($)	HIGH SCENARIO SAVINGS FOR A 42' CHANNEL (1,000) 1996	2006	2016	2026	2036	2046
Bayou Casotte:							
Crude Oil (import)	0.105	1,810.9	1,810.9	1,810.9	1,810.9	1,810.9	1,810.9
Petroleum Coke (export)	3.16	4,609.2	4,609.2	4,609.2	4,609.2	4,609.2	4,609.2
Subtotal		6,420.1	6,420.1	6,420.1	6,420.1	6,420.1	6,420.1
Pascagoula River:							
Bulk Grain (export)	1.09	2,317.4	2,317.4	2,317.4	2,317.4	2,317.4	2,317.4
TOTAL		8,737.5	8,737.5	8,737.5	8,737.5	8,737.5	8,737.5

CHANNEL:	UNIT SAVINGS ($)	LOW SCENARIO SAVINGS FOR A 42' CHANNEL (1,000) 1996	2006	2016	2026	2036	2046
Bayou Casotte:							
Crude Oil (import)	0.035	603.6	603.6	603.6	603.6	603.6	603.6
Petroleum Coke (export)	2.58	2,451.3	2,451.3	2,451.3	2,451.3	2,451.3	2,451.3
Subtotal		3,054.9	3,054.9	3,054.9	3,054.9	3,054.9	3,054.9
Pascagoula River:							
Bulk Grain (export)	0.89	838.2	838.2	838.2	838.2	838.2	838.2
TOTAL		3,893.0	3,893.0	3,893.0	3,893.0	3,893.0	3,893.0

Note: Totals may not sum due to rounding.

TABLE 43
SENSITIVITY ANALYSIS - AVERAGE ANNUAL EQUIVALENT TRANSPORTATION BENEFITS
FOR A 39' CHANNEL AT PASCAGOULA RIVER AND A 42' CHANNEL AT BAYOU CASOTTE
PASCAGOULA HARBOR
(1 October 1991 Prices; 8 3/4% Interest)
($1,000)

	LOW SCENARIO	ACTUAL BENEFITS	HIGH SCENARIO
DEEPENING:	($)	($)	($)
Bayou Casotte:			
Crude Oil (import)	603.6	603.6	1,810.9
Petroleum Coke (export)	2,451.3	3,142.7	4,609.2
Subtotal	3,054.9	3,746.3	6,420.1
Pascagoula:			
Bulk Grain (export)	609.8	677.6	745.4
Subtotal (Deepening)	3,664.7	4,423.9	7,165.5
WIDENING BAR/PASS:			
Bayou Casotte Vessels	922.9	1,025.4	1,127.9
Pascagoula River Vessels	68.8	76.4	84.0
Subtotal	991.6	1,101.8	1,212.0
NEW TURNING BASIN:	1,051.6	1,168.4	1,285.2
TOTALS	5,707.9	6,694.1	9,662.7

Note: Totals may not sum due to rounding.

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4. Ibid.

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8. Op. cit. (1980-1986)

9. Ibid.

10. Grain, Drewry Shipping Consultants, Ltd., June 1988, Table 6.1

11. World Sea Trade Service, DRI/McGraw-Hill and Temple, Barker and Sloane, Inc. (Spring, 1989), p. 79 (Table 10)

12. Telephone conversation with Mr. Ron Trussel, USDA/ERS, 25 April 1989.

13. "World Grain Situation and Outlook," USDA, Circular FG 7-89, loc. cit.

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15. "World Grain Situation and Outlook", USDA, Circular FG 7-89, loc. cit.

16. Pascagoula Harbor, Mississippi Feasibility Report, loc. cit.

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18. Ibid.

19. Merchant Fleet Forecast of Vessels in US-Foreign Trade, May, 1978, Temple, Barker & Sloane, Inc. Management and Economic Counsel, Wellesley Hills, Massachusetts, under contract for U.S. Department of Commerce, Maritime Administration.

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21. World Bulk Fleets, Drewry Shipping Consultants, Ltd., London, 1987/8, Table 6.2, p. 54.

22. Forecast Dry Bulk Carrier Profitability, 1988-1992, Drewry Shipping Consultants, Ltd., London, 1988, p. 3.

23. World Bulk Fleets, loc. cit., Tables 3.5, 3.9 and 3.11.

24. Feasibility Report, loc. cit.

25. Waterborne Commerce of the U.S., Part 2, 1978-1987, loc. cit.

26. Data furnished by Southern Steamship Agency at each port.